CONSTRUCTION CONTRACT

New York City
Department of
Environmental Protection
59-17 Junction Boulevard
Flushing, New York 11373

Lisa F. Garcia
Commissioner

Joseph Vaicels
Assistant Commissioner,
Agency Chief Contracting Officer

Invitation for Bids Furnishing all Labor and Material Necessary and Required for:

Contract: **PS-318**

Description: **Reconstruction of Paerdegat Pumping Station**

Volume 3 of 3
Contract Terms and Specifications
(with separate Bid Booklet)

September 2026

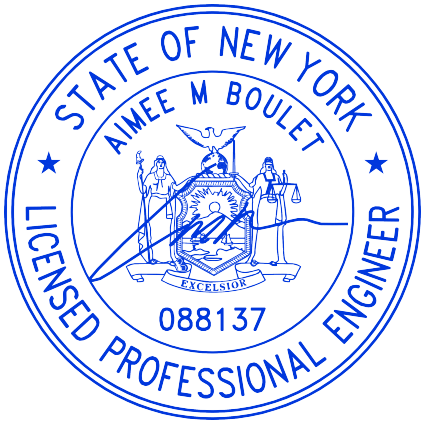
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT PS-318

RECONSTRUCTION OF PAERDEGAT PUMPING STATION

SEAL AND CERTIFICATIONS

Design Professional: AECOM, 605 Third Avenue, New York, NY 10158

Aimee Boulet, PE License No. NY PE - 088137  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Division 01, except for ○ Section 01 35 44 – Working on Hazardous (Classified) Locations ○ Section 01 35 45 – Hazardous Materials Control ○ Section 01 43 15 – Witness Shop Testing ○ Section 01 43 20 – Approval of Product Manufacturers ○ Section 01 51 11 – Temporary Water and Sanitary Services ○ Section 01 51 12 – Temporary Heat and Ventilation ○ Section 01 51 30 – Temporary Electrical System ○ Section 01 51 40 – Interim Power ○ Section 01 51 50 – Interim Pumping System ○ Section 01 55 00 – Vehicular Access and Parking ○ Section 01 55 26 – Traffic Control ○ Section 01 56 00 – Temporary Barriers and Enclosures ○ Section 01 57 00 – Temporary Controls ○ Section 01 73 17 – Installation of Equipment

	○ Section 01 74 17 – Cleaning and Site Maintenance ○ Section 01 78 24 – Spare Parts and Maintenance Materials ○ Section 01 78 25 – Operations and Maintenance Manuals ○ Section 01 79 05 – Equipment Start-up and Training ○ Section 01 91 00 - Commissioning

Design professionals' seals and signatures do not apply to the documents that comprise the Bid Booklet, Standard Construction Contract, Schedule of Wage Rates and General Conditions.

It is a violation applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this Contract.

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Design Professional: AECOM, 605 Third Avenue, New York, NY 10158

Tom Fini, PE License No. NY PE - 109219  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Section 01 43 15 – Witness Shop Testing • Section 01 43 20 – Approval of Product Manufacturers • Section 01 51 11 – Temporary Water and Sanitary Services • Section 01 51 12 – Temporary Heat and Ventilation • Section 01 51 50 – Interim Pumping System • Section 01 73 17 – Installation of Equipment • Section 01 78 24 – Spare Parts and Maintenance Materials • Section 01 78 25 – Operations and Maintenance Manuals • Section 01 79 05 – Equipment Start-up and Training • Section 01 91 00 - Commissioning • Section 40 05 05 – Exposed Piping Installation • Section 40 05 05.30 – Leakage Testing for Exposed Piping • Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping • Section 40 05 19 – Ductile Iron Process Pipe

	• Section 40 05 53 – Process Valve Four-Inch Diameter and Larger • Section 40 05 56 – Process Valves, Smaller than Four-Inch Diameter • Section 40 05 59.05 – Stainless Steel Slide Gates • Section 40 05 96 – Vibration and Seismic Controls for Process Equipment • Section 40 05 97 – Identification for Process Equipment • Section 40 06 01 – Schedule for Exposed Piping • Division 41 • Division 43

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NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT PS-318

RECONSTRUCTION OF PAERDEGAT PUMPING STATION

SEAL AND CERTIFICATIONS, continued

Design Professional: Matrix New World Engineering, 20 West 37th Street, 12th Floor, New York, NY 10018

Stephen Fung, PE License No. NY PE - 108763  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Section 01 35 44 – Working in Hazardous (Classified) Locations • Section 01 35 45 – Hazardous Materials Control • Section 01 55 00 – Vehicular Access and Parking • Section 01 55 26 – Traffic Control • Section 01 57 00 – Temporary Controls • Section 01 74 17 – Cleaning and Site Maintenance • Division 02 • Division 31 • Division 32, except for: • Section 32 31 19 – Decorative Metal and Wood Fences and Gates • Division 33

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CONTRACT PS-318

RECONSTRUCTION OF PAERDEGAT PUMPING STATION

SEAL AND CERTIFICATIONS, continued

Design Professional: AECOM, 605 Third Avenue, New York, NY 10158

Mostafa Elmorsi, PE License No. NY PE - 085573  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Division 03, except for: • Section 03 45 00 – Precast Architectural Concrete • Division 04, except for: • Section 04 21 02 – Exterior Brickwork • Section 04 40 00 – Stone Assemblies • Division 05, except for: • Section 05 40 00 – Cold-Formed Metal Framing • Section 05 52 13.07 Aluminum Pipe Railings • Section 07 90 00 – Joint Protection

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RECONSTRUCTION OF PAERDEGAT PUMPING STATION

SEAL AND CERTIFICATIONS, continued

Design Professional: AECOM, 605 Third Avenue, New York, NY 10158

Chen Li, RA License No. NY RA - 044981  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Section 03 45 00 – Precast Architectural Concrete • Section 04 21 02 – Exterior Brickwork • Section 04 40 00 – Stone Assemblies • Section 05 40 00 Cold-Formed Metal Framing • Section 05 52 13.07 Aluminum Pipe Railings • Division 06 • Division 07, except for: • Section 07 90 00 – Joint Protection • Division 08 • Division 09 • Division 10 • Division 11 • Section 32 31 19 – Decorative Metal and Wood Fences and Gates

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SEAL AND CERTIFICATIONS, continued

Design Professional: AECOM, 605 Third Avenue, New York, NY 10158

Eduardo Chaviano, PE License No. NY PE - 111609  Eduardo J Chaviano	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Division 21 • Division 22 • Division 23 • Section 40 05 07 – Hangers and Supports for Process Piping • Section 40 05 15 – Copper and Brass Process Pipe

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CONTRACT PS-318

RECONSTRUCTION OF PAERDEGAT PUMPING STATION

SEAL AND CERTIFICATIONS, continued

Design Professional: ELECSYS, 200 Summit Lake Drive, Suite 260, Valhalla, New York 10595

Eldo James, PE License No. NY PE - 088309  	The seal and signature to the left apply to the following Specifications Divisions and/or Specification Sections of this Contract: • Section 01 51 30 – Temporary Electrical System • Section 01 51 40 – Interim Power • Division 26 • Division 28 • Section 40 61 13 – PMCS General Requirements • Section 40 61 26 – PMCS Training • Section 40 61 93 – PMCS Input Output List • Section 40 61 94 – PMCS Instrument Index • Section 40 61 95 – PMCS Monitoring and Control Criteria • Section 40 61 96 – PMCS Control Strategies • Section 40 63 43 – PMCS Programmable Logic Controllers • Section 40 67 16 – PMCS Panels and Enclosures • Section 40 70 01 – Measurement • Section 40 78 90 – PMCS Panel Mounted Instruments and Devices • Section 40 79 91 – PMCS Field Instruments • Section 40 80 81 – PMCS Factory Testing • Section 40 80 82 – PMCS Startup and Field Testing

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(NO FURTHER TEXT THIS PAGE)

TABLE OF CONTENTS
CONTRACT PS-318
RECONSTRUCTION OF PAERDEGAT PUMPING STATION

VOLUME 3 OF 3

SPECIFICATIONS

Division/ Section No.	Division/ Section Title	Page No.
DIVISION 02	EXISTING CONDITIONS	
02 24 20	Soil Sampling and Analysis	998
02 41 10	Demolition and Removals	1016
02 82 05	Asbestos Management	1028
02 83 05	Lead Management	1056
02 84 05	PCB Management	1084
DIVISION 03	CONCRETE	
03 01 30.71	Rehabilitation of Cast-in-Place Concrete	1116
03 10 00	Concrete Forming and Accessories	1128
03 21 00	Reinforcing Steel	1144
03 30 00	Cast-in-Place Concrete	1162
03 32 00	Joints in Concrete	1252
03 35 00	Concrete Finishes	1268
03 35 16	Heavy-Duty Concrete Floor Finishing	1280
03 41 00	Precast Structural Concrete	1298
03 45 00	Precast Architectural Concrete	1314
03 60 00	Grouting	1328
DIVISION 04	MASONRY	
04 01 00	Maintenance of Masonry	1336
04 05 00	Common Work Results for Masonry	1342
04 21 02	Exterior Brickwork	1350
04 22 00	Concrete Unit Masonry	1362
04 40 00	Stone Assemblies	1380

DIVISION 05 METALS

05 05 13.01 Galvanizing 1390
05 05 23.01 Welding 1398
05 05 23.02 Miscellaneous Metal Fastenings 1408
05 06 00.01 Schedules for Stainless Steel Work 1422
05 12 00 Structural Steel Framing 1434
05 40 00 Cold-Formed Metal Framing 1448
05 50 00 Metal Fabrications 1454
05 51 00 Metal Stairs 1466
05 52 13.05 Welded Pipe Railings (Stainless Steel) 1472
05 52 13.07 Aluminum Pipe Railings 1490
05 53 01.02 Stainless Steel Floor Gratings 1510
05 56 00.01 Miscellaneous Metal Castings 1516
05 56 00 Metal Castings 1522
05 59 16 Fabricated Metal Access Hatches 1538

DIVISION 06 WOODS, PLASTICS, AND COMPOSITES

06 05 01 Untreated Timber and Lumber 1550
06 10 00 Rough Carpentry 1554

DIVISION 07 THERMAL AND MOISTURE PROTECTION

07 22 16 Roof Board Insulation 1562
07 32 00 Roof Tiles 1576
07 53 00 Elastomeric Membrane Roofing 1590
07 62 00 Sheet Metal Flashing and Trim 1606
07 71 00 Roof Specialties 1616
07 73 23 Manufactured Gutters and Downspouts 1626
07 72 33 Roof Hatches 1634
07 72 33.02 Roadway Hatches 1640
07 84 00 Firestopping 1648
07 90 00 Joint Protection 1658

DIVISION 08 OPENINGS
08 11 19 Stainless Steel Doors and Frames 1670
08 31 13 Access Doors and Frames 1680
08 51 13 Aluminum Windows 1686
08 51 23 Steel Windows 1710
08 71 01 Finish Door Hardware 1728
08 81 03 Glass, Plastic and Glazing 1750
08 91 20 Fixed Louvers 1760
08 92 00 Louvered Enclosure 1766

DIVISION 09 FINISHES
09 29 00 Gypsum Board 1772
09 30 13 Ceramic Tiling 1780
09 91 00 Painting 1786

DIVISION 10 SPECIALTIES
10 14 01 Identifying Devices 1812
10 28 10 Toilet and Bath Accessories 1820
10 75 00 Flagpoles 1824

DIVISION 11 EQUIPMENT
11 13 13 Loading Dock Bumpers 1832

DIVISION 21 FIRE SUPPRESSION
21 10 00 Water-Based Fire-Suppression Systems 1836

DIVISION 22 PLUMBING
22 07 00 Plumbing Piping Insulation 1858
22 10 00 Plumbing Piping 1872
22 13 29 16 Submersible Sewerage Pumps 1884
22 40 00 Plumbing Fixtures 1894

DIVISION 23 HVAC

23 05 93 Testing, Adjusting, and Balancing for HVAC....1912
23 07 13 Duct Insulation....1922
23 11 00 Fuel Oil System....1932
23 31 14 Metal Duct and Accessories....1952
23 33 00 Refrigerant Piping....1974
23 34 00 HVAC Fans....1982
23 37 00 Air Outlets and Inlets....2008
23 62 26 Packaged Variable Refrigerant-Flow Air-Conditioning Systems....2016
23 72 13 Heat-Wheel Air-to-Air Energy-Recovery Equipment....2030
23 74 16 Packaged Rooftop Air-Conditioning Units....2040
23 83 33 Electric Radiant Heaters....2052

DIVISION 26 ELECTRICAL

26 05 11 General Electrical Requirements....2070
26 05 14 Medium-Voltage Wires, Cables and Accessories....2076
26 05 20 Low-Voltage Wires, Cables and Accessories....2090
26 05 27 Grounding....2104
26 05 29 Hangers and Supports for Electrical Systems....2110
26 05 33 Raceways and Boxes for Electrical Systems....2116
26 05 43 Underground Ducts Manholes and Raceways for Electrical Systems....2136
26 05 48 Vibration and Seismic Controls for Electrical Systems....2146
26 05 53 Identification for Electrical Systems....2172
26 05 73 Power System Studies....2178
26 05 75 Shock Hazard and Arc Flash Studies....2192
26 05 91 Low-Voltage Electric Motors....2202
26 06 11 Cable and Conduit Schedule....2222
26 08 11 General Electrical Testing....2226
26 09 13 Electrical Monitoring and Communications Systems....2234
26 21 17 Low-Voltage Service Entrance Switchboards....2289
26 21 18 Integrated Service Equipment....2299
26 22 13 Low-Voltage Distribution Transformers....2313
26 24 13 Switchboards....2319
26 24 16 Panelboards....2343
26 24 19 Motor Control Centers....2357
26 28 13 Low-Voltage Fuses....2387
26 29 13 Enclosed Controllers....2391
26 32 13 Engine Generators....2401

26 32 23	Generator Quick-Connect Cabinets	2425
26 33 53	Static Uninterruptible Power Supple	2439
26 36 23	Automatic Transfer Switches	2455
26 41 13	Lightning Protection for Structures	2465
26 43 13	Low-Voltage Surge Protective Devices	2475
26 51 11	Lighting Fixtures, Devices and Schedules	2487
26 56 11	Outdoor Lighting	2501
DIVISION 28	ELECTRONIC SAFETY AND SECURITY	
28 23 10	Video Surveillance	2509
28 31 00	Fire Detection and Alarm	2549
DIVISION 31	EARTHWORK	
31 09 16.20	Pile Load Tests, Compressive, Lateral and Uplift Loads	2573
31 10 10	Site Clearing	2581
31 23 16	Excavation	2595
31 23 19	Dewatering	2617
31 23 23	Fill	2629
31 25 10	Dust, Soil Erosion and Sediment Control	2643
31 40 00	Shoring and Underpinning	2657
31 63 33	Drilled Micropiles	2667
DIVISION 32	EXTERIOR IMPROVEMENTS	
32 12 16	Asphalt Paving	2679
32 14 10	Pavers	2705
32 16 13	Curbs and Gutters	2717
31 31 19	Decorative Metal and Wood Fences and Gates	2725
32 90 00	Planting	2737
32 90 05	Soil Mixes	2761
DIVISION 33	UTILITIES	
33 01 10.60	Disinfection of Piping, Tanks, Structures, and Equipment	2777
33 05 05	Buried Piping Installation	2783
33 05 05.30	Leakage Testing for Buried Piping	2795
33 06 01	Schedule for Buried Piping	2815
33 39 10	Sanitary and Storm Sewer Structures	2821
33 42 10	Reinforced Concrete Sewer Pipe	2829

DIVISION 40	PROCESS INTERCONNECTIONS	
40 05 05.30	Leakage Testing for Exposed Piping	2839
40 05 05	Exposed Piping Installation	2847
40 05 06	Couplings, Adapters, and Specials for Process Piping	2873
40 05 07	Hangers and Supports for Process Piping	2891
40 05 15	Copper and Brass Process Pipe	2909
40 05 19	Ductile Iron Process Pipe	2921
40 05 31	Thermoplastic Process Pipe	2937
40 05 53	Process Valves Four-Inch Diameter and Larger	2945
40 05 56	Process Valves, Smaller than Four-Inch Diameter	2995
40 05 59.05	Stainless Steel Slide Gates	3011
40 05 59.16.01	Stop Logs (316L S.S.)	3039
40 05 96	Vibration and Seismic Controls for Process Equipment	3049
40 05 97	Identification for Process Equipment	3058
40 06 01	Schedule for Exposed Piping	3087
40 23 19.01	Pipe Supports	3093
40 61 13	PMCS General Requirement	3107
40 61 26	PMCS Training	3133
40 61 93	PMCS Input Output List	3141
40 61 94	PMCS Instrument Index	3219
40 61 95	PMCS Monitoring and Control Criteria	3229
40 61 96	PMCS Control Strategies	3247
40 63 43	PMCS Programmable Logic Controllers	3261
40 67 16	PMCS Panels and Enclosures	3283
40 70 01	Measurement	3305
40 78 90	PMCS Panel Mounted Instruments and Devices	3317
40 79 91	PMCS Field Instruments	3329
40 80 81	PMCS Factory Testing	3357
40 80 82	PMCS Startup and Field Testing	3365

DIVISION 41 MATERIAL PROCESSING AND HANDLING EQUIPMENT

41 22 13.13 Bridge Cranes and Appurtenances....3377
41 22 23.19 Monorail Hoists....3393

DIVISION 43 PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

43 05 21 Common Work Results for Pumping Units....3405
43 12 33 Reciprocating Air Compressor....3429
43 13 60 Vacuum Priming System....3441
43 21 00.80 Flow Conditioning Devices and Appurtenances....3455
43 23 31.05 Vertical Centrifugal Pumping Units (Dry Pits Submersible for Raw Wastewater Service)....3461
43 41 13 Welded Steel Tanks....3489

NO TEXT ON THIS PAGE

SECTION 02 24 20 – SOIL SAMPLING AND ANALYSIS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, tools, and equipment to perform all operations necessary to characterize, classify and determine the requirements for handling, reuse, and disposal of all materials to be excavated.

B. The primary method of characterizing soils shall be through in-situ sampling. No stockpiling of excavated material on-site or ex-situ sampling will be allowed without written approval from the Engineer.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	6
1.06	Quality Assurance	9
1.07	Submittals	9
1.08	Delivery, Storage, and Handling	13
1.09	Spare Parts, Special Tools, and Supplies	17
1.10	Warranty	17
PART 2	PRODUCTS	17
2.01	Manufacturers	17
2.02	Materials / Equipment	17
2.03	Fabrication / Assembling / Finishes	17
2.04	Source Quality Control / Shop Tests	17
PART 3	EXECUTION	17
3.01	Examination / Preparation	17
3.02	Implementation	18
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	18
3.05	Adjusting / Protection / Cleanup	18

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 27 - Environmental, Health and Safety Requirements

B. Section 01 35 45 - Hazardous Materials Control

C. Section 01 74 20 - Construction Waste Management

D. Section 31 23 19 - Dewatering

E. Section 31 23 16 - Excavation

F. Section 31 23 23 - Fill

G. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

1.04 REFERENCES

A. Definitions

1. Analyte-free Water: Water containing less than the detection limits for volatile organics, pesticides, PCBs, and inorganics. Compliance shall be verified either by the supplier or by an analytical laboratory.

2. Case-Specific Beneficial Use Determination (BUD): Under 6 NYCRR Part 360, Section 360.12(d), NYSDEC sets forth the requirements for petitioning NYSDEC to obtain a Case-Specific BUD, and the criteria for reviewing, granting, or denying of the BUD. For reuse of a solid waste to be determined a beneficial use, the petition must satisfy all criteria outlined under 6 NYCRR Part 360, Section 360.12(d).

3. Composite Sample: Composite sampling is comprised of grab samples which are initially collected from within a grid area and then combined into a single sample. This sample is representative of the entire grid area from which the grab samples were collected.

4. Excavated Material: All material regardless of its nature, except rock or boulders that have been excavated. Refer to Section 31 23 16 – Excavation.

5. Ex-situ Soil Sampling: Sampling of soil that has been excavated and stockpiled.

6. Fill: Soil and similar material excavated or brought to the Project Site for the purposes of construction. All fill material must meet the requirements of Section 31 23 23 – Fill. Fill from an off-site source shall be non-hazardous.

7. Grab/Discrete Sample: A single sample is collected at a particular time and place that represents the composition of the soil only at that time and place.

8. In-situ Soil Sampling: Sampling of soil prior to excavation and most representative of undisturbed conditions.

9. New York City Metropolitan Area Waste Impact Zone: The area encompassing the City of New York and the counties of Nassau, Suffolk, Putnam and Westchester, as per 6 NYCRR Part 360.2 Definitions.

10. Pre-Determined Beneficial Use for fill material: Under 6 NYCRR Part 360, Section 360.13(b) Waste cessation. “Excavated material ceases to be solid waste in accordance with the following:

a. Fill Type 1 generated outside of the New York City Metropolitan Area Waste Impact Zone (NYCMAWIZ) – once a determination has been made that the material is Fill Type 1;

b. Fill Type 1 generated within Nassau, Suffolk, Westchester and Putnam Counties – once the material is delivered to the site of reuse;

c. Fill Type 1 cannot be generated within the City of New York;

d. Fill Type 2 and Fill Type 3 generated outside of the NYCMAWIZ – once a determination has been made that the material is Fill Type 2 or Fill Type 3;

e. Fill Type 2 and Fill Type 3 generated within the NYCMAWIZ – once the material is delivered to the site of reuse;

f. Fill Type 4 and Fill Type 5 – Once the material is delivered to the site of reuse."

g. Under 6 NYCRR Part 360, Section 360.12(c)(1)(iv)(a), "Excavated material used to backfill the same excavation or as grade adjustment in areas of similar physical characteristics on the site of generation. If the material exhibits visual or historical evidence of contamination (including odors) and will be used in an area with public access, the material must be covered with pavement, foundation, or with a minimum of 12 inches of soil or fill that meets the criteria to be used as Fill Type 1 and Fill Type 2" as defined in Subdivision 360.13, Special requirements for pre-determined beneficial use of fill material.

11. Qualified Environmental Professional (QEP): "a person who possesses sufficient specific education, training, and experience necessary to exercise professional judgment to develop opinions and conclusions regarding the presence of releases or threatened releases to the surface or subsurface of a property or off-site areas, sufficient to meet the objectives and performance factors for the areas of practice identified" in 6 NYCRR Part 360.The QEP must:

a. Hold a current professional engineer's or a professional geologist's license or registration issued by the State or another state, and have the equivalent of three years of full-time relevant experience; or

b. Be a site remediation professional licensed or certified by the Federal government, a state or a recognized accrediting agency, to perform investigation or remediation tasks consistent with department guidance, and have the equivalent of three years of full-time relevant experience. Examples include:

i. Licensed Site Professional, by the State of Massachusetts;

ii. Licensed Environmental Professional, by the State of Connecticut;
iii. Licensed Site Remediation Professional, by the State of New Jersey;
iv. Qualified Environmental Professional by the Institute of Professional Environmental Practice (now the Board of Certified Safety Professionals); or
v. Certified Hazardous Materials Manager, by the Institute of Hazardous Materials Management.

An Environmental Professional (EP) as defined in Section 01 35 27 – Environmental, Health and Safety Requirements may meet the requirements of a QEP.

12. Treatment, Storage, Disposal Facilities (TSDF): Includes, but is not limited to, all permitted facilities that treat, store, or manage disposal of regulated waste.

13. Waste Classification:

a. Regulated Solid Waste:

1) Construction and Demolition (C&D) Debris: Waste resulting from the construction, remodeling, repair and demolition of structures, buildings, and roads. Such waste includes fill material, demolition wastes, and construction wastes. Materials that are not C&D debris (even if generated from construction, remodeling, repair, and demolition activities) include municipal solid waste, friable asbestos-containing waste, corrugated container board, electrical fixtures containing hazardous liquids such as fluorescent light ballasts or transformers, fluorescent lights, furniture, appliances, tires, drums, fuel tanks, containers greater than 10 gallons in size, and any containers having more than one inch of residue remaining on the bottom.

2) Hazardous Solid Waste: Material shall be considered a characteristic hazardous solid waste when it exhibits any of the following: ignitability, corrosivity, reactivity, or toxicity for Volatile Organic Compounds (VOCs), semi-VOCs (SVOCs), metals, pesticides, or herbicides, as defined in 6 NYCRR Part 371 or 40 CFR Section 261. Under New York State (NYS) regulations, a material that contains 50 ppm or greater of PCBs is considered a hazardous waste. The Environmental Protection Agency (EPA) considers a material that contains 50 ppm or greater of PCBs to be a Toxic Substances Control Act (TSCA)-regulated waste. All hazardous waste shall be considered unsuitable for reuse and shall be disposed of at an approved permitted hazardous waste landfill.

3) Non-Hazardous Contaminated Waste: Non-hazardous contaminated waste includes soil commingled with or containing other waste, petroleum and petroleum products, except those present solely as a result of normal use of vehicles on roadways or parking areas, and pesticides except those present solely as a result of the proper application in normal agricultural or horticultural practices. Physical evidence that soil is contaminated shall include visual identification of waste, chemical odors, vapor emission, and chemical staining.

4) Non-hazardous Petroleum-contaminated Waste: Exhibits a discernible petroleum-type odor, contains visible petroleum product, or may be associated with a reported spill.

b. Non-regulated Solid Waste: This applies to materials that, before being beneficially used (as determined by the NYSDEC or applicable out-of-state regulatory agency) were solid waste. Material used as described in 6 NYCRR Part 360, specifically Section 360.12(c) and Section 360.12(d) is no longer considered solid waste.

B. Reference Standards

1. EPA QA/G-4, Guidance on Systematic Planning Using the Data Quality Objectives Process, February 2006 or latest revision

2. USEPA Office of Solid Waste, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW-846), Third Edition, December 1996 with updates or latest revision

3. USEPA 40 CFR Chapter I, Subchapter R, - Toxic Substance Control Act (TSCA), Part 761 Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

4. NYSDEC regulations, 6 NYCRR Part 360, Solid Waste Management Facilities General Requirements

5. NYSDEC regulations, 6 NYCRR Part 371, Identification and Listing of Hazardous Wastes (40 CFR Part 261)

6. NYSDEC regulations, 6 NYCRR Part 375, Environmental Remediation Programs

7. American Society for Testing and Materials (ASTM) Standards:

a. D422 - Method for Particle-Size Analysis of Soils.

b. D1556 - Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

c. D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

d. D6938 - Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.05 DESCRIPTION

A. Sampling Requirements

1. Fill Material:

a. Material to be excavated and proposed for reuse as fill under a Pre-Determined Beneficial Use must meet the requirements of 6 NYCRR Part 360, Section 360.13(a), Applicability, Section 360.13(b), Waste Cessation, or Section 360.12(c)(1)(iv)(a). If these criteria cannot be met, such material must meet Section 360.12(d), Case-specific beneficial use determinations - general.

b. Under 6 NYCRR Part 360, Section 360.13, soil may be determined by the Contractor's QEP to be suitable for reuse onsite, without sampling, if any of the following criteria can be satisfied:

1) Excavated material originates from a location outside of the City of New York with no evidence of historical contamination based on site use, reported spill events, or visual and other indications (odors, etc.) of chemical or physical contamination discovered prior to excavation, or that no visual indication of chemical or physical contamination is discovered during excavation, as referenced in Part 360.13(d)(2).

2) "Fill material originates from a location within the City of New York unless the quantity of fill material does not exceed ten cubic yards from one site and the ten cubic yards or less of material does not exhibit historical evidence of contamination based on site use, reported spill events, or visual or other indicators (odors, etc.) of chemical or physical contamination" as referenced in Part 360.13(d)(1).

3) Excavated material used to backfill the same excavation or as grade adjustment in areas of similar physical characteristics on the site of generation under 6 NYCRR Part 360, Section 360.12(c)(1)(iv)(a).

c. Sampling, pursuant to 6 NYCRR Part 360, Section 360.13(d), is required when the above criteria cannot be met as determined by the Contractor's QEP. Fill material samples shall be analyzed for, at a minimum, metals, PCBs/pesticides, and SVOCs as listed in 6 NYCRR Part 375, Subdivision 375-6.8(b) per 6 NYCRR Part 360.13(e)(2)(i) In addition, and only if site conditions warrant, fill material shall also be analyzed for additional parameters as referenced in Part 360.13(e)(2)(ii-iv).

d. Sampling is performed within the planned excavation boundaries at frequencies as defined in 6 NYCRR Part 360, Section 360.13(e)(1), Table 1: Minimum Analysis Frequency for Fill, unless otherwise required by the beneficial use facility / treatment, storage, and disposal facility (TSDF).

e. Analytical data is used to determine acceptable fill material uses (Fill Types 1, 2, 3, 4 and 5), as defined in 6 NYCRR Part 360, Section 360.13(f), Table 2: Fill Beneficial Use.

f. If it is determined by the Contractor's QEP during construction that soils cannot be reused in New York State, additional sampling shall be performed to meet the out-of-state beneficial use facility / TSDF requirements.

g. When sampling is necessary for offsite, out-of-state reuse or disposal, excess soils shall be sampled for RCRA characteristics, including ignitability, corrosivity, reactivity, PCBs, asbestos, and TCLP for metals, SVOCs, VOCs, and pesticides and herbicides, in addition to any other parameters required by the reuse/disposal facility. Frequency of sampling shall be as required by the out-of-state reuse/disposal facility.

2. When relocating soils on the same Site, hazardous soils, non-soil wastes, or hot spots, as evidenced by visual observation, hand-held instruments or analytical results, must not be incorporated. All such material shall be removed for disposal off-Site. Soil sample results greater than 5 ppm lead by Toxicity Characteristic Leaching Procedure (TCLP) shall be reported to the Engineer immediately.

B. Off-Site Beneficial Use Facility / TSDF

1. The Contractor shall submit the name(s) of the selected off-Site soil beneficial use facilities / TSDFs and their location(s) to the Engineer for approval as part of the Soil Excavation, Treatment Reuse, and Disposal Plan specified in Section 31 23 16 – Excavation.

2. Reuse of excavation spoils off-Site must be prioritized over disposal. TSDFs shall only be approved where reuse options are not available.

3. Note that some companies may have multiple beneficial use facilities or TSDFs, each possessing differing requirements regarding the types of materials accepted, the specific analytical testing parameters that must be performed for each material, and the frequency of sampling required for each material. It is the Contractor's responsibility to determine the types of materials accepted, specific waste acceptance criteria (analytical parameters) and frequency of testing requirements for each of its proposed facilities.

4. The Contractor shall confirm the location(s) and permit status, as well as check for outstanding violations and enforcement actions at each selected

beneficial use facility / TSDF. The Engineer shall verify the information provided by the Contractor for each facility prior to approval.

5. If an approved facility is not available during construction, the Contractor shall be fully responsible for procuring alternate approved facilities at no additional cost to DEP. Any additional sampling and analysis required and labor involved in selecting new facilities after the initial reuse or disposal facilities are accepted shall be the responsibility of the Contractor.

C. Project Conditions

1. Stockpiling: No stockpiling of excavated material on-Site or ex-situ sampling of excavated soils will be allowed without written approval from the Engineer. Soils stockpiled for onsite reuse do not require sampling if they meet the conditions in Article 1.05.A.1.b.

   a. If stockpiling is considered necessary, and approved by the Engineer, sampling shall be conducted by collecting representative grab samples throughout the soil stockpile. Surface soil shall not be used as sampling material. Sampling frequency and analytical requirements will at a minimum conform to the sampling requirements specified herein. Multiple samples shall be classified based on biased worst case to be considered fully representative of the soils being sampled for reuse in New York State. The Contractor is also required to satisfy the specific sampling requirements of the beneficial use facility or TSDF.

   b. During stockpiling activities, the Engineer may identify quantities within each 300 cubic yard portion that differ in appearance from the bulk of the material as per 6 NYCRR Part 360, Section 360.13(e)(1) Table 1. In this case, the Engineer will direct the Contractor to segregate these variable materials for separate stockpiling on-site. The Contractor shall sample each stockpile that differs in appearance from the bulk of the material.

   c. All stockpiles of excavated materials shall be managed on site as required in Section 31 25 10 – Dust, Soil Erosion and Sedimentation Control.

2. Decontamination of Sampling Equipment: All sampling equipment shall be certified clean or precleaned, prior to collection of each sample, by the following method:

   a. Wash all sampling equipment, secondary containers (e.g., mixing bowls for composite sampling) and aluminum foil with non-phosphate laboratory grade detergent and distilled water.

   b. Triple rinse with distilled water.

   c. Rinse with isopropyl alcohol, or if samples are visibly contaminated with petroleum use a solvent, such as hexane or other alternate approved by the Engineer.

d. Triple rinse with analyte-free water.

3. Disposal of Decontamination Solutions: Collect all decontamination solution and dispose of it through a licensed chemical waste disposal service if unsuitable for treatment on-site by incorporation into existing on-site treatment processes as defined in Section 31 23 19 – Dewatering.

1.06 QUALITY ASSURANCE

A. Laboratory Requirements:

1. The Contractor shall provide the services of a laboratory certified by the New York State Department of Health Environmental Laboratory Approval Program (NYSDOH-ELAP) to perform applicable testing and chemical analyses for the duration of the Work.

2. The laboratory shall also meet the certification requirements of the beneficial use facility / TSDF that will be utilized by the Contractor for the duration of the Work.

B. Permits and Regulations:

1. The Contractor shall obtain all necessary permits and perform all work in compliance with applicable requirements of OSHA, and other governing authorities having jurisdiction including all federal, state, and local governing authorities.

C. Field QA/QC Samples:

1. Shall be collected and analyzed in accordance with the protocol for site samples.

2. The number of QA/QC samples required for a quantity of soil shall meet all beneficial use facility / TSDF requirements, and the approval of the Engineer.

D. Sample Turn-Around: The Contractor shall provide for prompt sampling and turn-around of analysis so as not to delay the Project. If a turn-around time of less than ten (10) business days is required due to delays in construction scheduling or other constraints, Contractor shall provide for such at no additional cost to DEP.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and other materials, including, but not limited to, those listed below for the approval of the Engineer. Where the Contractor's QEP determines that no sampling is required, at a minimum a Field Sampling Plan (FSP) per Article 1.07.A.2 shall be submitted describing a procedure for encountering potentially contaminated material during excavation as described in 1.05.A.2.

1. DEP Environmental, Health, and Safety (EHS) Drilling and Boring Checklist: The Contractor shall work with the Engineer and BEDC to complete all necessary portions of the EHS Drilling and Boring Checklist. This shall be completed and submitted to the Engineer a minimum of 60

days prior to the proposed commencement of the drilling/boring work. No drilling/boring work shall be performed at the Site without completion and written approval of the EHS Drilling and Boring Checklist from the Engineer. Updates to the checklist shall be completed and submitted whenever there is a change of the drilling subcontractor or scope of drilling/boring work; or new EHS hazards have to be considered in performing the work.

2. Field Sampling Plan (FSP): A FSP, prepared by the Contractor's QEP, shall be submitted to the Engineer for approval 30 days following notice to proceed. The Engineer will approve the FSP only if it clearly provides a means to collect the information necessary to allow for classification of all material proposed for excavation and if it will ultimately generate data necessary for on-site reuse as per 6 NYCRR Part 360, Section 360.13, or Section 360.12, or to gain approval from the Contractor's chosen off-Site beneficial use facility / TSDF. No sampling shall be conducted until the Engineer has reviewed and formally approved the FSP in writing. The FSP shall include the following at a minimum:

   a. Locations and protocols for the collection and analysis of samples that represent all soils to be excavated. Collection methods and chosen locations shall be sufficient to pre-characterize the soil prior to excavation unless post-excavation sampling is approved by DEP.

   b. Each composite sample will be comprised of multiple (3-5) discrete samples that are representative of the horizontal and vertical extent of the excavation footprint.

      1) When soils are visibly heterogenous, composite and discrete (for VOCs), samples will be obtained to represent each visually different stratum or section of the excavation site, regardless of the overall excavation volume.

   c. A detailed outline of the BUD or beneficial use facility / TSDF requirements for sampling, testing and analysis including specific number and types of samples per unit volume of soil to be excavated.

   d. Parameters analyzed for soils to be reused or disposed, as defined in 6 NYCRR Part 360, Section 360.13 (e), in addition to any other parameters required by the beneficial use facility / TSDF.

   e. A scaled site map showing:

      1) existing fixed landmarks;

      2) proposed excavation limits or area to be excavated divided into distinct vertical and horizontal grids, identifying the volume of soil or fill that each sample will represent;

      3) specific sampling locations that are representative of the entire depth of excavation and that will conform to the applicable sampling frequency requirement;

4) identification numbers of the sample grids, relative depth, sampling intervals, and volumes reflective of the Contractor's excavation method.

a) Sampling intervals shall account for existing subsurface data, historic sampling information, including descriptions, depths, orientation, and location of material of potentially different classifications, and shall minimize undue mixing of excavated soils.

f. Proposed sampling, handling, preservation, and storage of equipment procedures, including transfer procedures, and sampling equipment decontamination procedures.

g. Proposed analytical methods, in accordance with SW-846, latest edition, for the analyses to be performed. Contractor shall confirm the analytical method and laboratory selected is accepted/certified by the receiving facility, including beneficial use facility/TSDF, meets the regulatory requirements, and can meet the required reporting limits for comparison to beneficial use facility/TSDF accepting criteria and other limits, as applicable.

h. Procedures for assessing precision, accuracy, degree of representation, comparability and completeness of samples and data, including performance audits and proposed protocols for corrective measures where problems are identified in accordance with Article 1.06 -- Quality Assurance.

i. Schedule of field inspections.

j. A statement that the sampling program is in accordance with the Contract requirements.

k. Manufacturer, catalog data and calibration records of all analytical equipment to be used on-site.

l. Name and address of analytical laboratory, copy of laboratory certification, and Quality Assurance Manual.

m. Description of field and laboratory QA/QC samples and any additional requirements of the reuse or disposal facilities.

n. The organizational structure of the Contractor's and all subcontractors' quality management (QM) personnel, including:

1) names, titles and contact information;

2) resumes;

3) responsibilities;

4) authorities; and

5) qualifications.

3. Field Sampling Summary Report (FSSR): A FSSR, prepared by the Contractor's QEP, shall be submitted to the Engineer for review in a timeframe, dependent on the extent of the data collection effort, determined by the Engineer at the time. Contractor shall be solely responsible for ensuring that the FSSR meets all requirements of Contractor's proposed beneficial use facility/TSDF. The FSSR shall contain all laboratory analytical results obtained from the field sampling event and shall allow the Engineer to determine if the soil is acceptable for beneficial use or requires disposal at a permitted TSDF. At minimum, the FSSR shall include the following information:

   a. A detailed account of any field procedures used which deviated from or were in addition to those established in the FSP.

   b. A summary table listing the analytical results (with individual ID for each sample) with highlighted exceedances of 6 NYCRR Part 360, Section 360.13 (f), Table 2: Fill Material Beneficial Use, all Beneficial Use Facility/TSDF acceptance criteria, RCRA characteristics, and any other screening criteria identified and approved by the Engineer during the Project, as applicable.

   c. Location of each sampling point (using individual ID from analytical results summary table) on the scaled site map created in the FSP.

   d. A complete set of field notes collected and maintained by the Contractor during sampling. The field notes shall be made available to the Engineer during the sampling program.

   e. Boring or probe logs from each sampling location containing a continuous stratigraphic description of all material encountered. Descriptions of material shall include, but not be limited to, color, odor, staining, field screening measurement, relative grain size distribution, material composition, moisture content, and cohesive properties.

   f. Depth intervals for each sample, whether a grab or composite, and any special notes, which are included on the laboratory chain-of-custody forms.

   g. Copies of all laboratory chain-of-custody forms for samples that are collected for analysis.

   h. Analytical Results: The Contractor shall submit analytical results for sampled soil material to the Engineer within three (3) business days of receiving such data from the laboratory. Analytical results data shall be managed by utilizing a computer spreadsheet or database program compatible with NYSDEC requirements for EQuIS submittals as approved by the Engineer. Data shall be organized in such a way that all samples may be tracked from collection through analysis.

1) The analytical results generated for a ten (10) business day turn-around time deliverable shall include a Form I (or equivalent) showing compounds analyzed for, and concentrations detected, and associated chain-of-custody reports to the Engineer.

2) The final data package generated by the laboratory shall include the following information:

a) A Form I showing pertinent physical data presented in concise, easy to follow formats (i.e., sample number, laboratory ID, client, date of sample preparation, date analyzed, percent moisture, dilution factor, sample matrix, units, undetected and detected compounds, etc.).

b) Reference to analytical methodology used.

c) General discussion including a description of sample types, tests performed, any problems encountered, and any general comments (case narrative).

d) Data from each discrete sample reported using cross-referencing between site samples and quality control samples and including all pertinent dates, information and reporting limits.

e) Associated quality control samples such as blanks, spikes and spike duplicates, laboratory duplicates, laboratory control samples, field duplicates and appropriate check standards.

f) Copies of chain-of-custody sheets.

3) The information must be delivered on CD or via electronic mail to the Engineer. All electronic data must be certified to be virus-free.

B. Monthly Submittals: Monthly soil generation/diversion (onsite and offsite reuse)/disposal data shall be tracked in accordance with Section 01 35 27 – Environmental Health and Safety Requirements, paragraph 1.07.C Monthly Contractor EHS Report, and 01 74 20 – Construction Waste Management.

C. Coordinate all submittals with the Soil Excavation, Reuse, Transport and Disposal Plan (SERTD Plan) required in Section 31 23 16 – Excavation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Sample Identification:

1. All samples shall be identified with a sample label in addition to an entry on a chain-of-custody record. The label shall be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record.

2. Any inconsistencies shall be noted on the custody record. Laboratory personnel shall notify the Sampling and Analysis Manager immediately if any inconsistencies exist in the paper work associated with the samples, and Contractor shall collect new samples to replace those with inconsistencies which cannot be rectified.

B. Sample Labels: The field team shall complete the following information on a sample label for each sample bottle:

1. Site Name
2. Job Number
3. Sample Number
4. Sample Description
5. Company Name
6. Parameters to be analyzed
7. Date
8. Time
9. Preservation Technique Employed
10. Sample labels shall be attached to the sample bottles

C. Completion of Chain-of-Custody Record:

1. Maintain a chain-of-custody record on all samples. A chain-of-custody record is a printed multi-part form that accompanies a sample or group of samples as custody is transferred from person to person. A chain-of-custody record is a controlled document.

2. As soon as is practical after sample collection, preferably after decontamination, the following information shall be entered on the chain-of-custody form. All information shall be recorded in ink.

a. Project number: Enter the alphanumeric designation assigned by the field team that uniquely identifies the project site.

b. Project name: Enter the site name.

c. Samplers: Sign the name(s) of the sampler(s).

d. Station number: Enter the sample number for each sample in the shipment. This number appears on the sample identification label.

e. Date: Enter a six-digit number indicating the year, month, and day of sample collection.

f. Time: Enter a four-digit number indicating the time of collection in 24-hour time, for example, 13:54.

g. Matrix/Type: Indicate the type of sample; composite or grab.

h. Station location: Describe the location where the sample was collected.

i. Number of containers: For each sample number, enter the number of sample bottles that are contained in the shipment.

j. Remarks: Enter any appropriate remarks.

k. Sample Shipment:

3. Custody of samples shall be maintained throughout the shipment of samples to the selected laboratory (ies). All samples shall be packaged and shipped daily to ensure that no sample is held at the site more than 24 hours. Samples shall be delivered directly to the laboratory using the following procedures:

a. Use waterproof high-strength plastic ice chests or coolers only.

b. After filling out the pertinent information on the sample label and tag, put the sample in the bottle or vial and screw on the lid. For bottles other than VOC sample bottles, secure the lid with tape (tape on VOC bottles may cause contamination).

c. Place inert cushioning material such as vermiculite or "bubble-wrap" in the bottom of the cooler.

d. Enclose the bottles in clear plastic bags through which sample labels are visible, and seal the bag. Place bottles upright in the cooler in such a way that they do not touch and will not touch during shipment.

e. Put in additional inert packing material to partially cover sample bottles (more than half-way). Place double-bagged crushed ice around, among, and on top of the sample bottles.

f. Fill cooler with cushioning material.

g. Put paperwork (chain-of-custody record) in a waterproof plastic bag and tape it with packing tape to the inside lid of the cooler.

h. Tape the drain shut.

i. Secure lid by taping. Wrap the cooler completely with strapping tape at a minimum of two locations. Do not cover any labels.

j. Attach completed shipping label to top of the cooler.

k. Put "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of coolers containing glass containers.

l. Ship the cooler overnight by commercial carrier (e.g., Federal Express, UPS), laboratory carrier or field personnel to the respective laboratory.

m. Custody forms for the samples shall be signed by the Contractor's designated representative who is relinquishing custody. The custody

form shall include the air bill number, method of shipment, and time and date of the transfer of custody.

4. Custody seals shall be applied to the front and back of the sample coolers. A shipping label with return address shall be applied as well as the air express bill and any Department of Transportation (DOT) required labels or markings.

D. Transferring Custody of Samples to Shipper, if applicable: Contractor shall transfer custody of samples to a shipper as follows:

1. Sign, date, and enter time on the chain-of-custody report under "Relinquished by."

2. Make certain that shipper signs the "Received by" entry.

3. Enter name of the carrier under next "Relinquished by" category. Receiving laboratory shall sign "Received for Laboratory by" on lower line and enter date and time.

E. Transferring Custody from Sampler or Shipper to Common Carrier:

1. The shipper or Contractor shall transfer custody of samples to a common carrier as follows:

a. Sign, date, and enter time under "Relinquished by" entry.

b. Enter name of carrier (e.g., UPS, Federal Express) under "Received by."

c. Enter bill-of-lading or Federal Express airbill number under "Remarks."

d. Place the original of the chain-of-custody form in the appropriate sample shipping package. Retain a copy with field records.

e. Sign and date the custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field.

f. Wrap the seal across filament tape which has been wrapped around the hinges of the shipping package at least twice.

g. Fold the custody seal over on itself so that it sticks together.

h. Complete other carrier-required shipping papers.

i. In instances when the Common Carrier will not accept responsibility for handling chain-of-custody forms, the Contractor shall ensure that the record is packed within the sample package.

F. Laboratory Custody Procedures: Once the samples arrive at the laboratory, the Contractor shall ensure that custody of the samples is maintained by laboratory personnel. The laboratory shall, at a minimum, document the chain of custody through each stage of analysis from receipt to final reporting.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Testing shall be in accordance with the sampling requirements of Article 1.05.A.

1. Parameters analyzed for soils to be reused on-site per 6 NYCRR Part 360.13(e)(2), if the exemption for onsite reuse of soil does not apply or there are excess soils, shall include the following:

a. Total metals, Semi-volatile organic compounds (SVOCs), Volatile organic compounds (VOCs), and pesticides and herbicides;

b. RCRA characteristics, including ignitability, corrosivity, reactivity, and Toxicity Characteristic Leaching Procedure (TCLP) for metals, SVOCs, VOCs, and pesticides and herbicides;

c. Polychlorinated biphenyls (PCBs); and

d. Asbestos.

e. Volume of physical contaminants, if present;

2. Parameters analyzed for soils to be reused or disposed off-Site shall be the RCRA characteristics, including ignitability, corrosivity, reactivity, and Toxicity Characteristic Leaching Procedure (TCLP) for metals, SVOCs, VOCs, and pesticides and herbicides, in addition to any other parameters required by the beneficial use facility or TSDF.

3. If any soil sample results are greater than 5 ppm lead by TCLP the Contractor shall immediately notify the Engineer. (See Section 01 35 45 – Hazardous Materials Control for implementation of a Community Air Monitoring Program (CAMP) in the event that hazardous levels of lead are detected in soil.)

B. Field sampling shall be completed in ample time to prevent delay of the excavation work or the work of any other contractor.

3.02 IMPLEMENTATION

A. When relocating soils on the same Site, hazardous soils, non-soil wastes, or hot spots, as evidenced by visual observation, hand-held instruments or analytical results, must not be incorporated. All such material shall be removed off-site for proper disposal, treatment, and/or reuse as applicable.

3.03 FIELD TESTING / QUALITY CONTROL

A. Sampling frequencies shall be per Article 1.05.

B. Classification of soils for reuse or disposal shall be carried out by the Engineer.

C. Conduct testing in accordance with the approved FSP.

D. Calibrate all instruments in accordance with manufacturer recommendations.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to complete the demolition, removal, disposal and relocation Work.

B. Included, but not limited to, demolition and removals of existing materials, structures, equipment, or Work necessary to install the new Work, as shown and specified and to connect same with existing Work in an approved manner. Demolition includes structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical equipment, paving, curbs, walks, fencing, and similar existing facilities.

C. Demolitions and removals which may be specified under other Sections shall conform to requirements of this Section.

D. The Contractor shall obtain all required permits from the DEP and other agencies having jurisdiction.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	5
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Implementation	6
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 45 - Hazardous Materials

B. Section 02 24 20 - Soil Sampling and Analysis

C. Section 31 23 16 - Excavation

D. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

E. Section 33 01 10.60 - Disinfection of Piping, Tanks, Structures and Equipment

1.04 REFERENCES

A. 29 CFR 1926 - Safety and Health Regulations for Construction (Subpart T - Demolition)

B. 29 CFR 1910 - Occupational Safety and Health Standards

C. ANSI/ASSE A10 - Construction and Demolition Safety Standards

D. AWS D12.1 - Reinforcing Steel Welding Code

E. NYCDEP - Environmental Health and Safety Policies and Procedures – Vol. III. Control of Hazardous Energy Lock-Out/Tag-Out, or latest version

1.05 DESCRIPTION

A. Protection:

1. Demolition and removal Work shall be performed by competent workers experienced in the various types of demolition and removal Work required. The Work shall be carried through to completion with the prevention of damage to structures and the adjacent property and with due regard to the safety of City employees, work persons on the site, and the public. The Work will be performed so as not to interfere with the use of, and free and safe passage to and from, adjacent structures.

2. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the public, occupants of the building, work persons engaged in demolition operations, and adjacent construction.

3. The Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

4. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal, and

construction work is being done, connections made, materials handled, or equipment moved. The Contractor shall be responsible for any damage to the existing structure or contents by reason of providing insufficient protection.

5. The Contractor shall take necessary precautions to control dust as required by Section 31 25 10 – Dust, Soil Erosion, and Sediment Control. Dust shall be prevented from rising by wetting demolished masonry, concrete, plaster and similar debris. All portions of the existing buildings affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.

6. The Contractor shall monitor the atmosphere inside the aeration tanks, in particular for the presence of hazardous gases, in accordance with the requirements of this Contract and all applicable laws and regulations.

7. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.

8. The Contractor shall carry out all operations so as to avoid interference with operations and work in the existing facilities and the work under other contracts.

9. The Contractor shall be solely responsible for making all necessary arrangements and for performing all necessary Work involving the discontinuance or interruption of all utilities or services.

10. Any equipment, piping, and appurtenances removed without proper authorization, and that are necessary for the operations of the existing or expanded facilities, shall immediately be replaced to the satisfaction of the Engineer at no cost to DEP.

11. Closing or obstructing of roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials will not be permitted, and all operations shall be conducted with minimum interference to traffic.

12. The Contractor shall repair damage caused by its operations to existing structures and equipment to remain, or to any property belonging to the City or its employees.

13. The Work shall comply with 29 CFR Part 1926 -- Safety and Health Regulations for Construction, applicable provisions and recommendations of ANSI/ASSE A10 -- Construction and Demolition Safety Standards, New York City Construction Code, New York City Electrical Code, all other governing codes and rules, and as specified herein or shown in the Contract Documents.

14. The Contractor shall make such investigations, explorations, and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal.

15. Demolition and removal of hazardous materials shall be in accordance with applicable federal, State, and Local regulations.

B. Permits: The Contractor shall obtain all permits from all appropriate regulatory agencies required for closing or obstructing streets and sidewalks. Obtain all air permits as required for demolition of any building or structure located in New York City including a Demolition Permit from the Department of Buildings and a DEP Registration for Demolition from the Department of Environmental Protection, Bureau of Environmental Compliance.

C. Condition of Buildings, Structures and Equipment:

1. The DEP does not assume responsibility for the actual condition of buildings, structures and equipment to be demolished and removed.

2. Conditions existing at the time of inspection for bidding purposes will be maintained by the DEP so far as practicable. However, there is no guarantee by the DEP that the number of fixtures, amount of equipment, or any other material of value existing at bidding time in the buildings and structures to be demolished will be present in the structures when they are demolished. The Contractor shall have no claim against the DEP because of the absence of such fixtures and materials.

3. The conditions of existing structures and equipment shown on the Contract Documents is based on visual inspection and a walk-through survey only. Neither the Engineer nor the DEP will be responsible for interpretations or conclusions drawn therefrom by Contractor.

D. Scheduling: The Contractor shall carry out operations so as to avoid interference with DEP's operations and work in the existing facilities.

E. Notification: At least 48 hours prior to commencement of a demolition or removal, Contractor shall notify the Engineer in writing of his proposed schedule. DEP will inspect the existing equipment or facilities and review with the Contractor those items which are to remain the property of the DEP. No removals shall be started without the permission of the Engineer.

F. Coordination: The Contractor shall coordinate all electrical shutdowns with the Engineer and the Plant's Responsible Individual as defined in the DEP Policies and Procedures. The Contractor shall confirm all equipment is de-energized, and install required lock-out and tag-out devices on electrical equipment to prevent accidental re-energizing of the equipment.

G. Pre-Demolition Meeting:

1. The Contractor shall have a pre-demolition meeting with the Engineer and representatives of other related construction contracts, if any, in the presence of the Resident Engineer, to review all of the work areas that will be affected by the removal of materials from demolition.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to, proposed methods, equipment, and operating sequences to be used in performance of the demolition and removals Work and handling of hazardous materials.

B. The Contractor shall demonstrate how coordination of operations and sequence for shut-off, capping, temporary services, continuation of utility services, and other applicable items will be provided to ensure no interruption of City's operations.

C. Sequence and Schedule: The Contractor shall submit a detailed schedule showing the sequence and duration of demolition activities. Schedule shall include hours of operation when noise levels from demolition may approach applicable noise regulations or contract requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. General:

1. The Work required shall be done with care, and shall include all necessary shoring, bracing, and support to prevent movement, settlement, or collapse of existing structures or facilities. The Contractor shall be responsible for any damage caused by demolition and removal Work to any part or parts of existing structures or equipment designated for reuse or to remain. The Contractor shall perform patching, restoration and new work in accordance with applicable technical sections and details of the Contract Documents.

2. Surfaces of walls, floors, ceilings, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces, which have holes, scars, chipped or other damaged surfaces revealed by the removal, shall be repaired by the Contractor with the same or matching materials as the existing surface to result in matching color, gloss, texture and appearance or as may be otherwise approved by the Engineer.

3. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with Section 31 25 10 – Dust, Soil Erosion and Sediment Control and all governing regulations pertaining to environmental protection.

   a. Do not use water when it may create hazardous or objectionable conditions such as staining, mud, ice, flooding, and pollution.

   b. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

   c. The use of calcium chloride for dust control will not be allowed.

4. All supports, pedestals, and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts, and other supports shall be removed to approximately one inch below the surrounding finished area, and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of the Specifications, as shown on the Contract Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown on the Contract Drawings and as directed and approved by the Engineer.

5. Any materials or items designated to remain the property of the DEP shall be removed with care and stored at locations designated by the DEP.

6. Where equipment is shown or specified to be removed and relocated, the Contractor shall not proceed with removal of this equipment without the prior approval of the Engineer. Upon approval, and prior to commencing removal operations, the equipment shall be operated in the presence of representatives of the Contractor, DEP and the Engineer. Such items shall be removed with care, under the supervision of the trade responsible for reinstallation, and shall be protected and stored until required. Material or equipment damaged during removal shall be replaced with similar new material or equipment. Any equipment that is removed without proper authorization and is required for plant operation shall be replaced at no cost to DEP.

7. Wherever piping is to be removed for disposal, the Contractor shall drain the piping and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.

8. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations shall be of the same quality as required for new work of the same type.

9. The Contractor shall confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the Work. The Contractor shall cut and remove insulation and weather protection, and provide temporary weathertight protection as required until new roofing and flashings are installed.

10. The Contractor shall remove enclosures, signs, guards, and the like when no longer required or when directed by the Engineer at the completion of the Work.

11. The Contractor shall dispose of all demolition materials, equipment debris, and all other items not marked or specified by the DEP or the Engineer to remain as property of the DEP, off site and in conformance with the requirements of the Contract and all existing applicable laws and regulations.

12. Building Demolition:

    a. Unless otherwise approved by the Engineer the Contractor shall: proceed with demolition from the top of the structure to the ground. Complete demolition work above each floor or tier before disturbing supporting members of lower levels.

    b. Demolish concrete and masonry in small sections.

    c. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.

d. Break up and remove foundations and slabs-on-grade, unless otherwise shown to remain.

e. Locate equipment used for demolition work, and remove demolished materials, so as not to impose excessive loads on supporting walls, floors or framing.

f. Regrade in accordance with Section 31 23 16 - Excavation.

13. The Contractor shall de-energize and disconnect electrical service to all structures and equipment prior to demolition or relocation. No demolition activity shall commence prior to electrical disconnection.

14. All construction and demolition debris that has come in contact with regulated solid waste shall be cleaned to the satisfaction of the Engineer before leaving the site.

15. The use of explosives is not permitted.

B. Structural Removals

1. The Contractor shall remove concrete, structures, and sub-structures to the lines and grades shown unless otherwise directed by the Engineer. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the Contractor.

2. The Contract Drawings show approximate available information on thickness of existing concrete to be removed and the extent of reinforcement. It is the Contractor’s responsibility, before commencing the demolition work, to verify the thickness of existing concrete to be removed and the extent to which it is reinforced by suitable means as deemed necessary by the Contractor in the field. DEP does not guarantee the accuracy of existing concrete thickness to be removed or the extent of reinforcement shown on the Contract Drawings, as actual concrete thickness or reinforcement may vary. No additional compensation will be made because of variations from the thickness of concrete or for variations in the extent of reinforcement shown on the Contract Drawings.

3. All concrete, stone, masonry, roofing materials, reinforcement, structural, or miscellaneous metals, plaster, wire mesh, and other items contained in or upon the structure shall be removed and taken from the site and disposed of at a permitted facility. Demolished items shall not be used in backfill.

4. After removal of parts or all of masonry walls, slabs, and like work which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and finished surfaces exposed.

5. When conducting demolition activities on masonry materials (i.e., brick and concrete), the Contractor shall perform work area and personal exposure monitoring in accordance with applicable regulations and standard

industrial hygiene methods, until sufficient data is generated to demonstrate compliance with permissible exposure limits for crystalline silica, as calculated according to 29 CFR 1926.55 and 1926.57, employing exposure control methods specified in 29 CFR 1926.1153(c)(1). Compliance with permissible exposure levels must be demonstrated with a minimum of three (3) consecutive readings taken seven (7) days apart, for each new Work Task or change in equipment, process, or control measure.

C. Mechanical Removals

1. Mechanical removals shall consist of dismantling and removing existing pipes, pumps, motors, and other facilities as specified, shown, or required for the completion of the Work. It shall include cutting, capping, draining, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 40 of the Specifications.

2. Existing process, water, chemical, and other piping shall be removed where shown on the Contract Drawings. All removed piping shall be removed to the nearest solid support, capped and left in place. Piping shall be purged and made safe by the Contractor prior to removal or capping. Disposal of any chemicals or other purged material in accordance with the requirements of Section 01 35 45 - Hazardous Materials Control and other applicable environmental, health, and safety (EHS) requirements of the Contract shall be the responsibility of the Contractor. Where piping that is to be removed passes through existing walls, it shall be cut off and properly capped on each side of the wall.

3. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed.

4. Any required demolition or changes to potable water piping and other plumbing system work shall be made in conformance with all applicable codes. Portions of the potable water system that may have been altered or opened shall be pressure tested and disinfected in accordance with Section 33 01 10.60 – Disinfection of Piping, Tanks, Structures and Equipment and local codes. Other plumbing piping and heating piping shall be pressure tested only.

5. Provide all caps, plugs, blind flanges, shut-off valves, and other work and materials required to remove from service existing piping and necessary to keep existing piping in service where shown or required.

D. Pavement, Curb, and Sidewalk Removals:

1. Remove existing pavement, including base and surface courses, stabilized sub-bases, curbs, and gutters as required to construct new facilities or as shown. Before removing, saw a straight joint at least 1-1/2-inches deep

between sidewalk and pavement designated for removal and that left in place. Curbs and gutters shall be removed to the nearest construction joint beyond the limit of demolition shown on the Contract Drawings.

2. Provide for satisfactory transition between replaced pavement and sidewalks and the portions remaining in place.

E. Electrical Removals:

1. Electrical removals shall consist of the removal of existing generators, transformers, distribution switchboards, control panels, motors, conduits and wires, and miscellaneous electrical equipment all as shown, specified, or required to perform the work.

2. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage to keep existing systems in operation and maintain the integrity of the grounding systems.

3. Distribution switchboards shall be removed or modified as shown in the Contract Documents. Switchboards to be removed shall be disconnected and dismantled, and all components shall be disposed of off the site. Circuit breakers and other control equipment on modified switchboards that will no longer be used shall be removed unless otherwise shown or specified. All new openings cut into the modified switchboard panels shall be cut square and dressed smooth to the dimensions required for the installation of the new equipment.

4. Motors shall be disconnected and removed where shown or specified. Motors not marked or designated by DEP or the Engineer to be salvaged shall be removed from the site. Motors or other electrical gear designated for reuse shall be stored in enclosed, heated storage.

5. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged, turned over to DEP and stored where directed by the Engineer. Abandoned conduits concealed in floor or ceiling slabs, or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth, approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

6. The Contractor shall coordinate all electrical shutdowns with the Engineer and the facility's Responsible Individual as defined in the DEP Policies and Procedures. The Contractor shall confirm all equipment is de-energized, and install required lock-out and tag-out devices on electrical equipment to prevent accidental re-energizing of the equipment.

F. Miscellaneous Removals:

1. Contractor shall remove miscellaneous items where shown on the Contract Documents or where necessary for the construction of new structures or modification of existing structures. Anchor bolts shall be cut back one inch below the concrete surface and the hole patched.

G. Modifications and Closures:

1. Modifications shall conform to all applicable requirements of the Contract Documents, and the directions and approvals of the Engineer.

2. Where alterations require cutting or drilling into existing floors, walls, ceilings, and roofs, the holes shall be repaired in an approved manner. Contractor shall repair such openings with the same or matching materials as the existing floor, wall, ceiling, or roof, or as otherwise approved by the Engineer. All repairs shall be smoothly finished unless otherwise approved by the Engineer.

3. Openings in existing concrete slabs, ceilings, roofs, masonry walls, floors, and partitions which are not to be used in the new Work shall be closed and sealed as shown or otherwise directed by the Engineer.

4. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use. Remove concrete and masonry to the lines designated by drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp straight corners that will result in neat joints with new construction or be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing flush with the surface.

5. New Work shall be keyed into the existing in an acceptable manner. New reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, the same or matching materials as the existing adjacent surface shall be used. The finished closure shall be a smooth, tight, sealed, permanent closure with all exposed surfaces smooth finished and acceptable to the Engineer.

H. Maintenance and Clean Up:

1. Contractor shall maintain the buildings, structures, and other DEP properties free from accumulations of waste, debris, and rubbish caused by the demolition and removal operations.

2. Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish, and shall wet down dry materials to prevent blowing dust. Dump containers shall comply with applicable regulations and requirements of this contract and shall be secured in manner acceptable to Engineer.

3. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the Site and properties and dispose of all waste materials in accordance with the applicable regulations and requirements of this Contract.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 02 82 05 – ASBESTOS MANAGEMENT
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section details the requirements for construction and demolition activities affecting Asbestos-Containing Materials (ACM), trace asbestos materials (i.e., Building Materials containing 1% or less of asbestos), and Asbestos-Containing Waste Materials, as shown on Table Nos. Two (2), attached to Section 01 35 45 – Hazardous Materials Control, specified herein, or required to complete the Work, including all ACM identified and impacted by the Work.

B. All Work under this Section shall be performed to minimize the creation of airborne emissions; minimize the quantity of waste generated; protect the health and safety of all personnel and welfare of the public; and avoid adverse environmental impacts.

C. It should be noted that DEP Asbestos Projects being conducted on New York City property that is physically located outside of the five boroughs, would be subject to the requirements of 12 NYCRR 56, and not the requirements of RCNY Title 15, Chapter 1.

D. In the absence of analytical testing results for certain materials, the material shall be classified as suspect ACM pending the analytical results. Abatement of unforeseen or suspect/confirmed asbestos during the Work performed under this Section shall be in accordance with Section 01 35 45 – Hazardous Materials Control.

E. All Independent Third-Party air monitoring shall be outside this Contract and performed by others.

F. The Contractor shall label all known ACM in the field to prevent accidental disturbance by workers.

G. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	3
1.04	References	3
1.05	Description	12
1.06	Quality Assurance	13
1.07	Submittals	14
1.08	Delivery, Storage, and Handling	21
1.09	Spare Parts, Special Tools, and Supplies	21
1.10	Warranty	21
PART 2	PRODUCTS	22
2.01	Manufacturers	22
2.02	Materials / Equipment	22

2.03 Fabrication / Assembling / Finishes 22
2.04 Source Quality Control / Shop Tests 22
PART 3 EXECUTION.....22
3.01 Examination / Preparation 22
3.02 Implementation 24
3.03 Field Testing / Quality Control 24
3.04 Startup / Demonstration 26
3.05 Adjusting / Protection / Cleanup.....26

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s), or allowance(s) as set forth in Section 01 27 00 – Measurements and Payments.

B. At the completion of abatement activities, the Contractor is responsible for submitting all of the documentation required herein. Payment to abate and dispose of ACM and resulting Asbestos-Containing Waste Materials produced by this Work will not be made until all required documentation, including the following is provided to DEP:

1. Copies of all NYSDOL and DEP Asbestos Control Program (ACP)-approved Asbestos Project notifications, work permits, Variances, Work Place Safety Plans, and any applicable documentation filed or received from the NYSDOL and DEP ACP, including Notices of Violations (NOV).
2. Copies of the Asbestos Abatement Contractor's Handling license.
3. Copies of DEP and NYSDOL Asbestos Handler Supervisor and Asbestos Handler certificates, where applicable, for all workers engaged in the project.
4. A copy of the Asbestos Abatement Contractor's daily Isolation Barrier book (bound notebook). Copies of laboratory reports and Chain-of-Custody (COC) documents for Worker Exposure Monitoring conducted by the Asbestos Abatement Contractor, including the name, address, and New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) registration number of the laboratory used for air sample analysis (10 NYCRR 55-2).
5. All data related to bulk sampling, including the results of any asbestos surveys performed by a DEP-certified Asbestos Investigator and NYSDOL-certified Asbestos Inspector, where applicable.
6. The Asbestos Work Plan submitted and implemented in accordance with the requirements of this Section.
7. The total quantity of ACM abated.

8. The start and completion dates of the Asbestos Project(s).
9. A signed copy of the manifest(s) from the asbestos-permitted landfill with complete COC documentation, certifying the amount of asbestos waste delivered.
10. The name and address of the asbestos waste transporter.

1.03 RELATED SECTIONS

A. Section 01 35 27 – Environmental Health and Safety Requirements
B. Section 01 35 45 – Hazardous Materials Control
C. Section 01 41 00 - Regulatory Requirements
D. Section 01 51 11 – Temporary Water and Sanitary Services
E. Section 01 51 12 – Temporary Heat and Ventilation
F. Section 01 51 30 – Temporary Electrical System

1.04 REFERENCES

A. Definitions

1. Abatement: Any and all procedures physically taken to control fiber releases from ACM. This includes Removal, Encapsulation, enclosure, cleanup, and Repair.
2. Adequately Wet: Defined by the EPA (40 CFR 61.141) as a material sufficiently mixed or penetrated with amended water to prevent the release of Visible Emissions. If Visible Emissions are observed coming from an ACM or asbestos waste, then the material has not been "Adequately Wetted." However, the absence of Visible Emissions is not evidence of being Adequately Wet. ACM must be fully penetrated with the wetting agent to be Adequately Wet. If the ACM being abated is resistant to amended water penetration, the wetting agent shall be applied to the material prior to and during Abatement as necessary to minimize the potential for fiber releases.
3. Aggressive Air Sampling: A method of sampling within a Negative Pressurized Enclosure (NPE) in which mechanical equipment is used before and during the sampling period to stir up settled dust/asbestos fibers. Mechanical equipment includes 20-inch fans and forced air equipment (e.g., a one-horsepower leaf blower).
4. Air Sampling Technician: A person who performs Asbestos Project air sampling and possesses a valid Air Sampling Technician certificate issued by the NYSDOL.
5. Ambient Air Monitoring: The measurement or determination of airborne asbestos fiber concentrations outside but in the general vicinity of the Work

site, performed in accordance with NIOSH or EPA sampling methodologies.

6. Asbestos Abatement Contractor: A Subcontractor licensed by the NYSDOL who performs Abatement during an Asbestos Project, or employs persons performing such Abatement.

7. Asbestos Abatement Permit: A permit issued by the DEP ACP in accordance with RCNY Title 15, Chapter 1, authorizing the performance of construction Work for Asbestos Projects involving any of the activities defined in RCNY Title 15, Chapter 1-26(a) (1)-(13).

8. Asbestos Assessment Report (Form ACP-5): A form submitted to the DEP ACP by which a DEP-certified Asbestos Investigator certifies that a building or structure (or portion thereof) is free of ACM or the amount of ACM to be abated constitutes a Minor Asbestos Project.

9. ACM: Any material containing greater than one percent asbestos.

10. Asbestos Handler: An individual certified by the DEP and/or NYSDOL who disturbs, removes, encapsulates, repairs, or encloses ACM. Asbestos Handlers working on projects within the five boroughs shall possess both DEP and NYSDOL certifications. Asbestos Handlers working on projects outside of the five boroughs shall possess NYSDOL certifications.

11. Asbestos Handler Supervisor: An individual certified by DEP and/or NYSDOL who supervises the Asbestos Handlers during an Asbestos Project and ensures that proper asbestos Abatement procedures as well as individual safety procedures are being adhered to. Asbestos Handler Supervisors working on projects within the five boroughs shall possess both DEP and NYSDOL certifications. Asbestos Handler Supervisors working on projects outside of the five boroughs shall possess NYSDOL certifications.

12. Asbestos Project: Any Work performed in connection with the alteration, renovation, modification, or demolition of a building or structure, or in connection with the replacement or repair of equipment, pipes, or electrical equipment not located in a building or structure, which will involve the Abatement, Disturbance, or cleanup of friable or Non-Friable Asbestos. Asbestos Projects are classified as either Large Asbestos Projects, Small Asbestos Projects, or Minor Asbestos Projects in New York State and New York City, and each type of project involves several phases, which can include: background air monitoring, mobilization, pre-abatement/Containment construction, Abatement, cleaning/re-cleaning, final Clearance Air Monitoring, Containment breakdown, and demobilization.

13. Asbestos Project Notification (Form ACP-7): A form submitted to DEP ACP for all Large Asbestos Projects and Small Asbestos Projects. Minor Asbestos Projects do not require an ACP-7 form.

14. Asbestos-Containing Waste Material: ACM or asbestos-contaminated objects requiring disposal.

15. Building Materials: Any and all materials listed in 12 NYCRR 56-5.1(f)(1), including but not limited to interior and exterior finished, equipment, plaster, roofing, flooring, caulking, sealants, tiles, insulation, and mortar and refractory bricks used in the construction of boilers.

16. Clean Room: An uncontaminated area or room that is part of the Personal Decontamination Enclosure System, with provisions for the storage and changing of "street clothes" into clean Personal Protective Equipment (PPE).

17. Clearance Air Monitoring: Area air monitoring performed inside the Restricted Area and Regulated Abatement Work Area after the completion of the final cleaning, final waiting period, and Final Visual Inspection by the Asbestos Handler Supervisor and Project Monitor. Aggressive Air Sampling shall be performed as part of the Clearance Air Monitoring activities inside of the Containment.

18. Containment: The NPE within the Restricted Area, which establishes the Regulated Abatement Work Area, and surrounds the location where the asbestos Abatement is actually taking place.

19. Critical Barrier: A term used by the NYSDOL to define barriers that seal-off all openings to or within the defined Regulated Abatement Work Area, including but not limited to operable windows, skylights, doorways, ducts, grills, diffusers, and any other penetrations to surfaces adjacent to or within the Regulated Abatement Work Area.

20. Disturbance: Any activities that disrupt the matrix of ACM, or Asbestos-Containing Waste Materials. This includes activities that generate dust, debris, Visible Emissions, or airborne asbestos fibers, including moving friable ACM or Asbestos-Containing Waste Materials from one place to another.

21. Encapsulation: The coating or spraying of ACM, or the bare substrate surface that is exposed after an Abatement, with a pigmented (i.e., non-transparent) liquid sealant that creates a membrane over the surface of the material (bridging encapsulant) or penetrates into the material and binds its components together (penetrating encapsulant).

22. Excursion Limit: Defined in the OSHA Asbestos Standard for the Construction Industry (29 CFR 1926.1101) as individual exposure, without regard to the use of respirators, to an airborne concentration of asbestos fibers of 1.0 fiber per cubic centimeter of air (1.0 f/cc) averaged over a 30-minute sampling period. No employee of the Contractor shall at any time be exposed to concentrations of asbestos fibers above the Excursion Limit.

23. Worker Exposure Monitoring: Personal air sampling performed outside the respirator within the breathing zone of individuals that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee, for the purpose of determining compliance with OSHA's Asbestos Standard for the Construction Industry (29 CFR 1926.1101). Analytical results from Worker Exposure Monitoring will be used to select appropriate respiratory protection and PPE for individuals within a Restricted Area and Regulated Asbestos Work Area. For the purpose of this Section, Worker Exposure Monitoring samples shall be collected from individuals who are representative of each task being conducted by the Contractor, and all Worker Exposure Monitoring shall follow pertinent NIOSH or EPA sampling methodologies.

24. Final Visual Inspection: An inspection performed by the Project Monitor and Asbestos Handler Supervisor at the completion of the final waiting period on an Asbestos Project (but prior to Clearance Air Monitoring). The inspection is performed in accordance with ASTM E1368 to determine the completeness of Abatement and cleanup.

25. Friable Asbestos: A term used by the NYSDOL to define any ACM or asbestos waste that can be crumbled, pulverized or reduced to powder when dry, by hand pressure.

26. Glovebag: A manufactured, impervious, bag-like enclosure with two (2) inward-projecting long sleeve gloves, one (2) inward-projecting waterwand sleeve, an internal tool pouch, and an attached, labeled receptacle for asbestos waste. The Glovebag is constructed and installed to surround an object or area to be abated, and contain all asbestos fibers released during the Abatement process.

27. High-Efficiency Particulate Air (HEPA) Filter: A filter designed to remove 99.97% of all particles greater than 0.3 micrometers (μm) in diameter. For the purpose of this Section, HEPA vacuum and Negative Air Pressure Equipment (i.e., Microtraps) used by the Contractor shall meet the Standard for Safety High-Efficiency, Particulate, Air Filter Units (UL 586) developed by Underwriters Laboratories.

28. Holding Area: A room or area in the Waste Decontamination Enclosure System utilized for the temporary (i.e., no longer than the current work shift) storage of containerized asbestos waste, prior to its transfer to a final on-site storage container (i.e., dumpster, trailer, or roll-off) or a licensed asbestos waste transport vehicle. The Holding Area is located between the washroom and an uncontaminated area.

29. Independent Third-Party Monitor: A NYSDOL-licensed asbestos contractor who will be contracted by the Engineer or DEP, and is completely independent of the Asbestos Abatement Contractor involved with the Asbestos Project. The Independent Third-Party who conducts ambient and clearance air monitoring or Project Monitoring on an Asbestos

Project shall not have any business, personal, or other relationship with the Asbestos Abatement Contractor.

30. Isolation Barrier: A term used to define the construction of partitions, the placement of solid materials, and the plasticizing of apertures to seal off the Regulated Abatement Work Area from surrounding areas and contain asbestos fibers.

31. Large Asbestos Project: An Asbestos Project involving the Removal, enclosure, Encapsulation, Repair, Disturbance, cleanup, or handling of 260 linear feet or more of ACM, or 160 square feet or more of ACM.

32. Log: An official record, maintained by the Asbestos Abatement Contractor, of all activities that occurred during the Asbestos Project. The Log shall be in the form of a bound notebook, and at a minimum, identify the following information: (a) the building owner, agent, contractor, and workers; (b) daily activities, cleanings, and waste transfers; (c) the names and certificate numbers of all Asbestos Handlers and Asbestos Handler Supervisors; (d) the results of inspections of decontamination systems, barriers, and negative pressure ventilation equipment; (e) summaries of all corrective actions and Repairs; (f) work stoppages with reasons for stoppages; (g) manometer readings at least twice per work shift; (h) daily checks of emergency and fire exits; (i) any unusual events.

33. Microtrap: (See definition of “Negative Air Pressure Equipment”).

34. Minor Asbestos Project: An Asbestos Project involving the Removal, enclosure, Encapsulation, Repair, Disturbance, cleanup, or handling of 25 linear feet or less of ACM, or 10 square feet or less of ACM.

35. Negative Air Pressure Equipment: A local exhaust system capable of maintaining air pressure within the Containment at a lower pressure than the air outside of the Containment. The Negative Air Pressure Equipment also provides for the HEPA filtration of all air exhausted from the Containment.

36. Non-Friable Asbestos: A term used by the NYSDOL to define any ACM or asbestos waste that cannot be crumbled, pulverized or reduced to powder when dry, by hand pressure.

37. Obstruction: The blocking of a means of egress with any temporary structure or barrier. Polyethylene sheeting shall not be considered an Obstruction when it is prominently marked with exit signage or paint, and cutting tools (i.e., a knife or razor blade) are attached to the work area side of the sheeting for use in the event that the sheeting must be cut to permit egress. A corridor shall not be considered obstructed when there is a clear path measuring at least three feet wide.

38. OSHA Monitoring: (See definition of “Worker Exposure Monitoring”).

39. P-100 Filter: (See definition of: “HEPA”).

40. Perimeter Monitoring: (See definition of “Area Monitoring”).

41. Permissible Exposure Limit (PEL): Defined in the OSHA Asbestos Standard for the Construction Industry (29 CFR 1926.1101) as individual exposure, without regard to the use of respirators, to an airborne concentration of asbestos fibers of 0.1 fibers per cubic centimeter of air (f/cc) calculated as an 8-hour Time-Weighted Average (TWA). No employee of the Contractor shall at any time be exposed to concentrations of asbestos fibers above the PEL. See also Excursion Limit.

42. Personal Decontamination Enclosure System: A series of connected rooms designed to control the passage of Asbestos Handlers, and other authorized individuals into the Regulated Abatement Work Area from uncontaminated areas. The system consists of a Clean Room, a Shower Room, and an equipment room separated from each other and the Regulated Abatement Work Area by airlocks and curtained doorways.

43. Personal Monitoring: (See definition of “Worker Exposure Monitoring”).

44. Phase Contrast Microscopy (PCM): An analytical method (e.g., NIOSH 7400 and 7401) used for determining the asbestos fiber concentration in an air sample.

45. Polarized Light Microscopy (PLM): An analytical method (e.g., 40 CFR 763, Subpart F, Appendix A or ELAP Item 198.1 or 198.6) used for determining the asbestos content in a bulk material.

46. Post Abatement Air Monitoring: (See definition of “Clearance Air Monitoring”).

47. Presumed Asbestos-Containing Material (PACM): Material suspected of containing asbestos as described in 15 RCNY 1-38. PACM is considered to be ACM unless proven otherwise by appropriate bulk sampling and laboratory analysis.

48. Project Designer: A person who performs Asbestos Project design functions and possesses a valid Project Designer certificate issued by the NYSDOL.

49. Project Monitor: A person who performs Asbestos Project Monitoring functions and possesses a valid Project Monitor certificate issued by the NYSDOL

50. Regulated Abatement Work Area: The portion of the Restricted Area where Abatement Work actually occurs. This includes the interior of the Restricted Area Containment enclosure. For Glovebag operations, the areas contiguous to where the operation takes place are Regulated Abatement Work Areas. For tents, the interior of each tent is a Regulated Abatement Work Area. For exterior, Non-Friable Asbestos Abatement conducted without the establishment of negative air ventilation systems or Containment enclosures, the entire Restricted Area surrounding the

Abatement location is considered to be the Regulated Abatement Work Area.

51. Removal: The stripping of any ACM from surfaces or components of a building or structure.

52. Repair: A term used by the DEP to define a corrective action using specified work practices (e.g., Glovebags or tents) to minimize potential asbestos fiber releases from minimally damaged ACM.

53. Restricted Area: An area established and marked for the Abatement portion of an Asbestos Project. The area shall include, but not be limited to, Regulated Abatement Work Areas and any contiguous decontamination enclosure systems, adjoining staging areas where work materials, debris, or waste materials from such Work may accumulate, and waste storage areas (e.g., dumpsters, trailers, or roll-offs).

54. Shower Room: A room between the Clean Room and the equipment room in the Personal Decontamination Enclosure System set up to prevent cross-contamination by ensuring the removal of potential asbestos contamination from the body that may have accumulated during Abatement operations. The Shower Room shall have hot and cold running water controllable at the tap, shall be arranged for complete showering during decontamination, and shall include clean, dry towels, soap, and shampoo in quantities sufficient to accommodate the personnel working on the Asbestos Project.

55. Small Asbestos Project: An Asbestos Project involving the Removal, enclosure, Encapsulation, Repair, Disturbance, cleanup, or handling of more than 25 linear feet but less than 260 linear feet of ACM, or more than 10 square feet but less than 160 square feet of ACM.

56. Suspect ACM: All friable and non-friable materials suspected of containing asbestos as determined by a certified NYSDOL Asbestos Inspector and/or certified DEP Asbestos Investigator, which have not been sampled and analyzed for asbestos content. Suspect ACM includes PACM.

57. Tent: (See definition of “Containment”).

58. Transmission Electron Microscopy (TEM): An analytical method (e.g., 40 CFR 763, Subpart F, Appendix A or ELAP Item 198.4) used for determining the asbestos fiber concentration in an air sample, or for determining the asbestos content in a bulk material.

59. Trace Asbestos-Containing Material: A building material that contains less than or equal to 1% of asbestos.

60. Variance: Relief from specific requirements set forth in state or local asbestos regulations, which is granted in writing by the agency that enforces the regulations.

61. Visible Emission: Any emission containing particulate material that can be seen without the aid of instruments.

62. Waste Decontamination Enclosure System: A series of connected rooms designed to control the transfer of materials and equipment from the Regulated Abatement Work Area. The system consists of a washroom and a Holding Area separated from each other and the Regulated Abatement Work Area by airlocks and curtained doorways.

63. Wet Cleaning: The process of eliminating asbestos contamination from surfaces, equipment, or other objects by using cloths, mops, or other cleaning tools that have been saturated with amended water.

64. Worker Decontamination Enclosure System: (See definition of "Personal Decontamination Enclosure System").

65. Work Place Safety Plan: Construction documents prepared by a registered design professional and submitted for review to the DEP ACP in order to obtain an Asbestos Abatement Permit. The plan shall include, but not be limited to, plans, sections, and details of the Regulated Abatement Work Area clearly showing the extent, sequence, and means and methods by which the Work is to be performed.

B. Reference Standards:

1. The Contractor shall comply with all applicable regulations, standards, and guidelines of federal, state, and local environmental and occupational safety and health agencies regarding ACM, trace asbestos materials, and Asbestos-Containing Waste Materials. These regulations, standards, and guidelines include, but are not limited to the following:

   a. ASTM International:

      1) D2898 – Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing;

      2) E84 – Standard Test Method for Surface Burning Characteristics of Building Materials;

      3) E1368 – Standard Practice for Visual Inspection of Asbestos Abatement Projects.

   b. United States (U.S.) Department of Transportation (DOT):

      1) 49 CFR 171 - General Information, Regulations, and Definitions;

      2) 49 CFR 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response information, and Training Requirements;

3) 49 CFR 173 – Shippers: General Requirements for Shipments and Packagings;

4) 49 CFR 178 – Specifications for Packagings.

2. United States Environmental Protection Agency (EPA):

   a. 40 CFR 61 - National Emission Standards for Hazardous Air Pollutants (NESHAP);

   b. 40 CFR 262 - Standards Applicable to Generators of Hazardous Waste;

   c. 40 CFR 268 – Land Disposal Restrictions;

   d. 40 CFR 302 – Designation, Reportable Quantities, and Notification;

   e. 40 CFR 763 - Asbestos Hazard Emergency Response Act (AHERA).

3. National Institute for Occupational Safety and Health (NIOSH):

   a. Method 7400 – Asbestos and Other Fibers by PCM;

   b. Method 7401 – Asbestos by TEM.

4. National Fire Protection Association (NFPA):

   a. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials;

   b. NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

5. New York City Department of Environmental Protection (DEP):

   a. Environmental Health and Safety Policies and Procedures – Vol. II, Spill Prevention, Environmental Release Reporting and Investigation;

   b. Environmental Health and Safety Policies and Procedures – Vol. III, Asbestos Management;

   c. RCNY Title 15 Chapter 1 - Asbestos Control Program Rules and Regulations; RCNY Title 15 Chapter 19 – Discharges of Wastewater and Other Materials to Public Sewers.

6. New York City Department of Sanitation (DSNY):

   a. RCNY Title 16 Chapter 8 – Asbestos Rules and Regulations.

7. New York State Department of Environmental Conservation (NYSDEC):

   a. 6 NYCRR 360 - Solid Waste Management Facilities;

   b. 6 NYCRR 364 - Waste Transporter Permits;

   c. 6 NYCRR 376 – Land Disposal Restrictions.

8. New York State Department of Health (NYSDOH):
    a. 10 NYCRR 55-2 – Approval of Laboratories Performing Environmental Analysis.
9. New York State Department of Labor (NYSDOL):
    a. 12 NYCRR 56 - Asbestos Rules and Regulations.
10. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910 – Occupational Safety and Health Standards;
    b. 29 CFR 1910.28 – Safety Requirements for Scaffolding;
    c. 29 CFR 1926.65 – Hazardous Waste Operations and Emergency Response;
    d. 29 CFR 1910.134 - Respiratory Protection Standard;
    e. 29 CFR 1910.1001 - Asbestos Standard for General Industry;
    f. 29 CFR 1910.1200 - Hazard Communication Standard;
    g. 29 CFR 1926 - Safety and Health Regulations for Construction;
    h. 29 CFR 1926.1101 - Asbestos Standard for the Construction Industry.
11. Underwriters Laboratories, Inc. (UL):
    a. UL 586 – Standard for Safety High Efficiency, Particulate, Air Filter Units;
    b. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

1.05 DESCRIPTION

A. Commencement of Work: Ten (10) business days prior to the proposed start of Work at each separate location, the Contractor shall notify the Engineer, the onsite safety staff, and building occupants. No Work may proceed at any location until authorized by the Engineer.

B. The Contractor shall coordinate any required equipment shutdowns with the Engineer prior to starting the work.

C. Access Restrictions: The Contractor shall inform the Engineer of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed Asbestos Project), and provide them estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall notify Other Contractors in advance of the abatement Work included herein, to provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.

D. The Contractor shall ensure that Personal and Waste Decontamination Enclosure Systems along with the Regulated Abatement Work Area are constructed of solid materials with lockable doors to prevent unauthorized entry during non-working hours.

E. Meetings: In addition to the pre-construction meeting and site walk-through, other meetings may be required or may be requested by the Engineer, including briefings with Site Operations personnel. Written documentation (i.e., "minutes") of all meetings shall be generated by the Contractor, and copies shall be provided to DEP within three (3) business days following each meeting.

1.06 QUALITY ASSURANCE

A. Permits and Notifications: The Contractor shall make all necessary notifications, secure any necessary permits and Variances, complete agency-required forms, and pay all fees in conjunction with asbestos Abatement activities, waste transportation, and waste disposal in accordance with federal, state, and local asbestos regulations (as per Section 01 41 00 - Regulatory Requirements). Prior to the submittal of any notifications, permit/Variance applications, or forms to regulatory agencies, the Contractor shall provide them to the Engineer for review.

B. Scheduling: The Contractor shall coordinate and schedule all phases of the Work to be performed under this Section with DEP, subcontractors, material suppliers, and other parties as necessary to ensure the proper execution of the Work.

C. Compliance: In addition to the requirements of this Section, DEP EHS Policies and Procedures and Section 01 35 27 – Environmental Health and Safety Requirements, the Contractor shall comply with all applicable regulations of federal, state, and local authorities pertaining to the Abatement, disturbance, cleanup, handling, transportation, storage, and disposal of ACM, trace asbestos materials, and Asbestos-Containing Waste Materials. All matters regarding the interpretation of any regulations, standards, or policies shall be submitted to the Engineer for resolution before starting the Work. Where the requirements of this Section, DEP EHS Policies and Procedures, and federal, state, or local regulations conflict or vary, the most stringent requirements or regulations shall apply.

D. Rejection of Non-Complying Items: DEP reserves the right to reject Contractor submittal items, including proposed disposal facility, vendors, subcontractors or personnel with regulatory citations/violations, that it deems inappropriate or unacceptable by the Engineer or DEP. DEP further reserves the right, and without prejudice to other recourse, to accept non-complying items subject to an adjustment in the Contract amount, as approved by the DEP.

E. Suspect Material Characterization: All caulking and bitumastic coatings are considered suspect ACM. Therefore, if a confirmatory sample will be collected, the sampling shall be performed by a certified DEP Asbestos Investigator or NYSDOL Asbestos Inspector.

F. Qualifications:

1. Asbestos Abatement Contractor: The Contractor shall possess a current NYSDOL asbestos license and shall have successfully completed at least two (2) Asbestos Projects of comparable scope and methodologies within the past three (3) years. This experience shall be documented and provided as follows: (a) the name, address, and phone number of each facility where the work was performed; (b) the volume and type of each material that was abated; (c) the specific methods of Abatement (including the tools, technologies, and engineering controls employed);

2. Asbestos Handler Supervisor:

    a. Shall be currently certified by the DEP (if working on Asbestos Projects in the five boroughs) and NYSDOL (for all Asbestos Projects).

    b. Shall have a minimum of two (2) years of experience on Asbestos Projects, and shall have served as the Asbestos Handler Supervisor on at least three (3) Asbestos Projects of comparable scope and methodologies to the work being performed under this Section.

3. Asbestos Handler:

    a. Shall be currently certified by the DEP (if working on Asbestos Projects in the five boroughs) and NYSDOL (for all Asbestos Projects), and

    b. Shall have a minimum of one (1) year of experience on Asbestos Projects, and shall have worked on at least three (3) Asbestos Projects of comparable scope and methodologies to the Work being performed under this Section.

1.07 SUBMITTALS

A. Thirty (30) business days prior to commencement of the Work of this Section or as directed by the Engineer, the Contractor shall submit the following to the Engineer:

1. Asbestos Inspection and Sampling Plan: The Contractor shall provide an Asbestos Inspection and Sampling Plan to identify suspect asbestos-containing materials and collect confirmatory samples, as appropriate during the inspection.

2. The Asbestos Inspection and Sampling Plan shall include at a minimum:

    a. At a minimum, the inspection shall be performed by a certified NYSDOL Asbestos Inspector or a certified NYCDEP Asbestos Investigator (if performed within the City), who shall have OSHA 10-hour certification, and confined space entry training as applicable to the location or work, and shall have performed similar inspection work on at least three (3) projects of comparable scope.

b. Credentials of the laboratory providing sample analysis. The credentials shall include current certification by the NYSDOH ELAP.

c. Sample collection, analysis and reporting protocol in accordance with RCNY Title 15 Chapter 1 or 12 NYCRR Part 56, as applicable to the Work location.

d. Health and safety protocol (Job Hazard Analysis) for all investigation activities.

3. Asbestos Inspection Report: The Contractor shall provide an Asbestos Inspection Report summarizing the results of all inspection activities, and as applicable, a sampling narrative, laboratory data packages and an inventory, including photographs, of all identified suspect and confirmed asbestos-containing materials. All reporting shall be in accordance with RCNY Title 15, Chapter 1 or 12 NYCRR Part 56, as applicable to the Work location.

4. Asbestos Work Plan: The Asbestos Work Plan shall be prepared in accordance with RCNY Title 15, Chapter 1 or 12 NYCRR 56, all applicable DEP EHS Policies and Procedures, and all other pertinent federal, state, and local regulations. In addition, the Asbestos Work Plan shall be coordinated with the Engineer. The Asbestos Work Plan shall also be signed and dated by a NYSDOL-certified Project Designer, with a copy of the Project Designer's current NYSDOL certification, attached to the Work Plan. The Asbestos Work Plan shall include the following elements:

a. Asbestos Control:

1) Drawings showing the location and details of the following: (a) each Regulated Asbestos Work Area; (b) the type, location, and number of negative air pressure machines that will be used, as well as all exhaust locations; (c) proposed electrical hookups and temporary electrical panels; (d) proposed water hookups; (e) each Restricted Area; (f) each Personal Decontamination Enclosure System; (g) each Waste Decontamination Enclosure System; (h) each waste storage area (e.g., dumpster, trailer, or roll-off); (i) restroom areas; (j) areas designated for eating and drinking.

2) A section on the interfacing of trades (i.e., other contractors) and the sequencing of asbestos-related Work.

3) A section on the collection, handling procedures, cleanup, and disposal of Asbestos-Containing Waste Materials (including the collection, filtering, and disposal of wastewater).

4) A section on the procedures and methodologies that will be used to conduct Worker Exposure Monitoring, including the name and qualifications (i.e., training and experience documentation) of the individual who will be responsible for conducting the Worker Exposure Monitoring.

5) A section on housekeeping procedures to be used for maintaining clean Regulated Abatement Work Areas, clean Restricted Areas, and clean decontamination enclosure systems.

6) A section on the specific methods and procedures that will be used to control fiber releases, and ensure that as per 40 CFR Part 763, Subpart E, of the EPA Asbestos in Schools Rule measured by Phase Contrast Microscopy (PCM), fiber concentrations less than or equal to the clearance and action criteria of 0.01 f/cc of air, or background levels (whichever are greater), are not exceeded outside of each Regulated Abatement Work Area. For projects conducted outside of the five boroughs of New York City, the clearance and action criteria is less than 0.01 f/cc; of air, or background levels (whichever is greater).

7) Task Analysis: Each task analysis shall include, but is not limited to, the following information: (a) the type of Work activity; (b) the tools/equipment that will be used and their respective decontamination procedures; (c) the types of ACM that will be disturbed, or Asbestos-Containing Waste Materials that may be generated when performing the activity; (d) the engineering controls that will be used to control the spread of asbestos fibers during the activity; (e) the proposed crew size for the activity and individual employee responsibilities during the activity; (f) housekeeping procedures that will be used during the activity; (g) PPE and proposed respiratory protection that will be used for the activity.

8) Equipment and Supplies: Identify the materials and equipment that will be used to perform the Work, including materials and equipment designed to be non-combustible or fire retardant in accordance with NFPA 701 and 255. Materials and equipment utilized for Abatement activities that take place within the five boroughs, shall conform to RCNY Title 15 Chapter 1-61.

9) Rental Equipment Notification: If rental equipment is to be used during the Work, the Contractor shall notify the rental agency in writing concerning the intended use of the

equipment, and shall develop and submit an equipment decontamination plan to the Engineer for review and approval prior to the start of Work.

10) Safety Data Sheets (SDSs): Provide SDSs for all chemical products (including wetting agents and encapsulants) to be used for the Work.

b. Waste Management:

1) A description of the types of ACM and Asbestos-Containing Waste Materials associated with the Work (include details regarding whether the materials are friable or non-friable) as per 49 CFR 171 and 172.

2) The estimated quantity of each waste stream that will be generated as per 40 CFR 302.

3) Name, address, telephone number and current permit documentation for the disposal facility indicating that the facility is approved by federal, state, and local regulatory agencies to receive Asbestos-Containing Waste Materials.

4) Current 6 NYCRR 364 and 49 CFR 173 permit documentation for the waste transporter that will transport Asbestos-Containing Waste Materials from the Work Site to the disposal facility.

5) Spill prevention, Containment, and cleanup contingency measures to be implemented during a suspected fiber release or emergency situation.

6) A detailed discussion of the on-site handling, storage, removal, cleanup, and disposal of waste materials, including the following: (a) description of the waste storage areas; (b) the methods and procedures that will be used to collect and containerize wastes on a daily basis; (c) the types of bags/containers; (d) the submittal of weekly waste inspection records.

7) The name and qualifications of the Asbestos Handler Supervisor. At a minimum, the Asbestos Handler Supervisor shall be onsite during all activities affecting ACM.

c. Asbestos Abatement Project Notifications and Permits: Submit completed permits and notifications to the Engineer for review and approval prior to submittal to the applicable agencies. All Large Asbestos Projects and Small Asbestos Projects that take place within the five boroughs are required to follow notification and permitting procedures per RCNY Title 15, Chapter 1. All Large Asbestos Projects require notification procedures per 12 NYCRR 56.

Documents that may be required based upon the scope and location of the project include, but are not limited to, the following:

1) EPA Large Asbestos Project Notification;

2) DEP Asbestos Assessment Report (Form ACP-5);

3) DEP Asbestos Project Notification (Form ACP-7);

4) DEP Asbestos Project Amendment (Form ACP-8);

5) DEP Asbestos Variance Application (Form ACP-9);

6) DEP Asbestos Technical Review Unit Permit (A-TRU Permit);

7) DEP Work Place Safety Plan;

8) NYSDOL Asbestos Project Notification;

9) NYSDOL Asbestos Variance Application.

d. A detailed schedule for the implementation of the Asbestos Work Plan elements, including the different phases of the Asbestos Project, the projected start and completion dates for Restricted Area preparation, gross Removal and Abatement, cleanings, Clearance Air Monitoring, and demobilization activities.

e. Medical Surveillance: The Contractor shall provide a sufficient number of properly trained, experienced, and certified workers, each of whom shall: (a) have received a medical exam that included a Pulmonary Function Test (PFT) within the past year; (b) have received written medical clearance within the past year, by a licensed physician, to wear a respirator; (c) have received a qualitative or quantitative respirator fit-test within the past year for the specific respirator the employee will be using for this Work.

f. Employee Documentation: The Contractor shall provide a sufficient number of properly trained, experienced, and certified workers, each of whom shall: (a) have current NYSDOL-issued and DEP-issued asbestos certificates; (b) documentation for Asbestos Handlers and Asbestos Handler Supervisors, including required work experience; and (c) dates and written proof of respiratory clearance, including fit-test and medical examinations by the Contractor or other employer within the past year.

g. A current (i.e., within the last month) signed and notarized statement disclosing all of the Abatement Contractor's OSHA, EPA, NYSDOL, DEP, DSNY, and DOT citations/violations on Asbestos Projects within the past three (3) years.

h. A current (i.e., within the last month) signed and notarized statement disclosing all of the Asbestos Handler Supervisor's NYSDOL and DEP citations/violations within the past three (3) years.

i. Analytical Laboratory Qualifications for Analyzing Air Samples: Submit the name, address, and telephone number of each analytical laboratory, including copies of current AIHA and ELAP certificates along with dates of accreditation/reaccreditation. ELAP certificates should show evidence of certification for the specific analytical methods that will be used.

5. The Contractor shall submit all Worker Exposure Monitoring results to the DEP no later than 24-hours after the collection of the air samples.

B. Field Reports and Recordkeeping: The Contractor shall maintain and provide the following documentation:

1. Worker Exposure Monitoring Documentation: Worker Exposure Monitoring Documentation shall be made available to the DEP immediately upon request. All laboratory analytical results shall be accompanied by complete COC documentation.

a. The signed Worker Exposure Monitoring documentation shall include, but not be limited to, the following information: (a) sample "start" and "stop" times; (b) flow rates (initial and final) for each sample; (c) the total volume of air collected for each sample; (d) names of individuals being sampled along with the specific Work task each individual is performing; (e) specific respiratory protection and PPE worn by each individual; (f) types (i.e., makes and models) of sampling equipment used; (g) types of sample media (i.e., filters and cassettes) used; (h) the most recent calibration dates, along with the calibration results, for the sampling equipment used; (i) name of the individual who conducted the Worker Exposure Monitoring; (j) dates that the Worker Exposure Monitoring was conducted; (k) Work tasks being performed adjacent to the Restricted Area during the Worker Exposure Monitoring; (l) unique sample numbers used to identify each sample; (m) the phase of the Asbestos Project being performed (i.e., background, pre-abatement, Abatement, cleaning, or clearance).

2. Waste Manifest Documentation: A Waste Profile for all asbestos waste shall be completed and submitted to the Engineer for review and approval prior to DEP signature. The Contractor shall submit a Facility Letter of Acceptance form the selected asbestos-permitted landfill stating that the facility will accept the asbestos wastes generated during abatement. The Contractor shall also submit advance copies of the completed manifest for the Engineer's review and approval, prior to NYCDEP signature on the date of disposal. Following disposal, completed and signed waste manifests from the approved, asbestos-permitted landfill, shall be provided to DEP within

10 business days of disposal. In addition, on-site waste storage areas shall be inspected weekly by the Asbestos Handler Supervisor.

3. Waste Storage Area Inspection Documentation: Each weekly waste storage area inspection shall be documented in the Asbestos Abatement Contractor's bound Log. The Log shall be signed by the Asbestos Handler Supervisor, and shall be made available to DEP immediately upon request. The content of this documentation shall include, but not be limited to, the following information: (a) the name of the inspector; (b) descriptions of waste streams; (c) waste container type and quantity; (d) the current disposal status (i.e., when the waste container is scheduled to be removed from the Work Site) and physical condition of each waste container; (e) the present condition of each waste storage area; (f) proper label type; (g) storage area security method to prevent unauthorized entry.

4. Asbestos Project Inspection Documentation: Project Monitors and Restricted Areas shall be inspected daily by the Asbestos Handler Supervisor.

    a. Each daily Asbestos Project inspection shall be documented in the Asbestos Abatement Contractor's bound Log. The Log shall be signed by the Asbestos Handler Supervisor, and shall be made available to the DEP immediately upon request. The content of the Log shall include, but is not limited to, the following information: (a) the type of Asbestos Project (i.e., Large Asbestos Project, Small Asbestos Project, or Minor Asbestos Project) being conducted; (b) the current phase of the Asbestos Project (i.e., mobilization, background pre-Abatement, abatement, cleaning, Clearance Air Monitoring, or Containment breakdown); (c) the names of the Asbestos Handlers, Asbestos Handler Supervisors, Project Monitors, and Air Sampling Technicians on site, as well as the name of the company each individual is representing; (d) the types of air monitoring (i.e., Worker Exposure Monitoring or area monitoring) being conducted, and the number of samples being collected for each type of air monitoring activity; (e) the results of decontamination enclosure system, Critical Barrier, Isolation Barrier, and Negative Air Pressure Equipment inspections; (f) a summary of corrective actions and Repairs; (g) reasons for Work stoppages, if any; (h) manometer readings (at least twice per work shift); (i) emergency and fire exit checks; (j) verification that functional fire extinguishers are present in the Restricted Areas; (k) any unusual events that occurred during the Work; (l) non-compliance issues observed, including their corrective actions.

5. Contractor Project Record: The Asbestos Handler Supervisor shall maintain a project record in the Regulated Abatement Work Area. The Contractor Project Record shall be made available to the Engineer or DEP for review

at any time during the Asbestos Project, and shall be submitted to the DEP within 24- hours after the completion of the Asbestos Project.

a. At a minimum, the Contractor Project Record shall contain the following information: (a) copies of DEP and NYSDOL asbestos certificates/licenses for all individuals/companies working on the Asbestos Project; (b) copies of all notifications, amendments, permits, work safety plans, and Variances related to the Asbestos Project; (c) copies of all exposure and Ambient Air Monitoring results generated during the Asbestos Project; (d) documentation of all pressure differential readings for Regulated Abatement Work Areas; (e) copies of all available bulk sample analytical data as well as asbestos survey reports relating to the Asbestos Project; (f) copies of all daily sign-in sheets as defined in this Article; (g) a list of emergency phone numbers, including the local fire department, local police department, nearest hospital, as well as phone numbers for the Engineer and DEP personnel responsible for administering the Asbestos Project; (h) a copy of New York City's Asbestos Control Program Rules and Regulations (Title 15, Chapter 1); (i) a copy of New York State's Asbestos Rules and Regulations (12 NYCRR 56); (j) a copy of EPA's asbestos regulations (40 CFR 61, Subparts A and M); (k) copies of all SDSs pertaining to all chemicals being used during the Asbestos Project; (l) a copy of the Contractor's Asbestos Work Plan; (m) copies of all daily air monitoring reports as defined in this Article; (n) copies of all daily Asbestos Project inspection reports as defined in this Article; (o) copies of all weekly waste storage area inspection reports as defined in this Article.

6. Daily Sign-In Documentation: The Contractor shall generate daily sign-in documentation for all individuals entering and exiting each Regulated Abatement Work Area and Restricted Area, for the duration of the Asbestos Project. The daily sign-in documentation shall be maintained in the Asbestos Abatement Contractor's bound Log. The daily sign-in documentation shall be made available to the Engineer or DEP for review at any time during the Asbestos Project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Respirators: The Contractor shall select respirators approved by NIOSH for use in Regulated Abatement Work Areas where the Abatement or Disturbance of ACM or Asbestos-Containing Waste Materials will occur. If not included within the EHASP the Contractor shall submit their Respiratory Protection Program to DEP for review prior to abatement activities. At a minimum, the Contractor shall provide each individual within a Regulated Abatement Work Area with a half-face, negative pressure, air purifying respirator equipped with HEPA filter cartridges. The Contractor's Asbestos Handler Supervisor shall make all determinations regarding respiratory protection modifications that will be implemented for the Work. All modifications shall be in accordance with the OSHA Asbestos Standard for the Construction Industry (29 CFR 1926.1101) and the Contractor's Asbestos Work Plan. At no time during the Asbestos Project shall respiratory protection within a Regulated Abatement Work Area be downgraded to below the minimum requirement of a half-face, negative pressure, air purifying respirator equipped with HEPA filter cartridges.

B. PPE: The Contractor shall provide personnel who have a potential to be exposed to asbestos with appropriate PPE.

C. HEPA Filters: HEPA filters used in vacuuming equipment and Negative Air Pressure Equipment must meet or exceed any manufacturer's specifications and recommendations, as well as specifications presented in the Standard for Safety High Efficiency, Particulate, Air Filter Units (UL 586).

D. Containment Materials: Plastic sheeting used in the construction of temporary enclosures shall be fire retardant in accordance with NFPA 701. Wood or other materials used in the construction of temporary enclosures shall be non-combustible or fire-retardant in accordance with NFPA 255, ASTM D2898, ASTM E84 and UL 723.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Safe Work Practices for Trace Asbestos materials

1. An exposure assessment shall be performed in accordance with 29 CFR 1926.1101(f) (2) (i) to determine if workers disturbing, handling, or performing cleanup activities involving trace asbestos materials, must wear PPE or respiratory protection.
2. Wetting agents or special work methods shall be utilized to control potential employee exposures to asbestos during the handling, mixing, removing, cutting, application, or cleanup, of trace asbestos materials, except if the use of these wetting agents/work methods is not feasible (e.g., using them may create electrical hazards or equipment malfunctions).
3. Asbestos-contaminated wastes and debris shall be cleaned-up promptly and disposed of in leak-tight containers. The handling, disposal, and transport of Trace Asbestos-Containing Material wastes is not regulated since the wastes are not ACM (i.e., they do not contain greater than 1% asbestos).
4. The use of high-speed abrasive saws that are not equipped with "point-of-cut" ventilators or enclosures with HEPA-filtered exhaust air shall be prohibited.
5. The use of compressed air to cleanup or remove trace asbestos materials is prohibited.

B. Preparation

1. Utilities: The temporary use of any on-site utilities shall be subject to the approval of DEP. The Contractor shall furnish all water, hoses and water filtration devices needed for the Work as per Section 01 51 11 - Temporary Water and Sanitary Services; as well as any temporary electrical hookups and temporary lighting to the Asbestos Control Area as per Section 01 51 30 - Temporary Electrical System. All temporary lighting and temporary electrical service to an Asbestos Control Area shall be provided by the Contractor and shall be in weather-proof enclosures and be ground fault protected. Also, the Contractor shall supply all heating and ventilation equipment needed for the Work as per Section 01 51 12 - Temporary Heat and Ventilation.
2. Signs: The Contractor shall post conspicuous warning signs at all approaches to Regulated Abatement Work Areas, Restricted Areas, and waste storage areas. The signs shall be located at such a distance so that personnel may read the sign and take necessary precautions before entering a Regulated Abatement Work Area, Restricted Area, or waste storage area. Signs shall comply with the requirements of federal, state, and local regulations. Once Clearance Air Monitoring results indicate that a Regulated Abatement Work Area is in compliance with the provisions for re-occupancy set forth in RCNY Title 15, Chapter 1 or 12 NYCRR 56, the signs shall be removed. At a minimum, each sign shall bear the following information in English and the predominant language that is spoken by the Contractor's employees if English is not spoken:

DANGER
ASBESTOS CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA
NO SMOKING

C. Fire Extinguishers: The Contractor shall maintain at least two functional fire extinguishers in each Restricted Area. The fire extinguishers shall have a minimum rating of 2-A:10-B:C, and each fire extinguisher shall be checked daily by the Asbestos Handler Supervisor to ensure that it remains functional throughout the duration of the Asbestos Project.

D. Walkthrough: The Abatement Contractor shall perform a walkthrough with the Other Contractors in advance of the abatement Work included herein, to identify and mark the locations of the potential asbestos containing materials (ie. Wall penetrations, insulation, gaskets, etc.).

3.02 IMPLEMENTATION

A. Bulk Removal

1. Protection of Existing Work to Remain: All Work involving the Abatement or Disturbance of ACM or Asbestos-Containing Waste Materials, must be conducted without damage to, or contamination of equipment or surfaces within the Regulated Abatement Work Areas, Restricted Areas, or other areas adjacent to these areas. All such damage or contamination shall be immediately corrected and cleaned up by the Contractor at the Contractor's expense.

2. Containments and Negative Air Pressure Equipment: Pressure differential readings for each workday shall be obtained, documented in the Contractor’s Project Record, and reviewed by the Asbestos Handler Supervisor on a daily basis. The Asbestos Handler Supervisor shall notify the Engineer and the DEP immediately, if any variations in the pressure differential readings may have led to the migration of asbestos fibers outside of a Regulated Abatement Work Area. Corrective actions shall be implemented immediately to ensure that negative pressure is restored.

3. Personal Decontamination Enclosure System: The Contractor shall ensure that employees do not leave a Regulated Abatement Work Area wearing any potentially contaminated protective work clothing or PPE. Employees are required to shower prior to leaving the Regulated Abatement Work Area.

3.03 FIELD TESTING / QUALITY CONTROL

A. Air Monitoring

1. Air monitoring for airborne concentrations of asbestos fibers shall be conducted by the Asbestos Handler Supervisor (or by a qualified air monitoring firm) in accordance with OSHA.

    a. Worker Exposure Monitoring: Worker Exposure Monitoring shall be conducted during each phase of the Asbestos Project (e.g., pre-abatement, Abatement, and cleanup) for one (1) Work shift from at least one (1) employee that is representative of each type of Work task that is being performed. Each personal air sample will "run" for the employee's entire Work shift in order to ensure that enough volume (of air) is collected and an accurate 8-hour TWA can be calculated. Representative 30-minute short-term employee exposures shall also be conducted and shall be determined on the basis of one or more samples representing 30-minute exposures associated with operations that are most likely to produce exposures above the excursion limit for employees in each Regulated Abatement Work Area as per OSHA 1926.1101(f)(1)(iii). Documentation regarding the sample numbers, specific shift when the sampling was conducted, the Work tasks that were sampled, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

    b. Complete documentation of all Worker Exposure Monitoring activities shall be in accordance with this Article.

    c. The Contractor shall submit all Worker Exposure Monitoring results to DEP within 24- hours from when the air samples were collected.

    d. If at any time, PCM analysis of any air sample (i.e., from Worker Exposure Monitoring performed by the Contractor) in any phase of the Asbestos Project (i.e., pre-abatement, Abatement, cleanup, or clearance) indicates that the filter was "overloaded" and a fiber count cannot be obtained, the sample shall immediately undergo TEM analysis. All costs of the additional TEM analysis will be at the Contractor's expense.

2. Area Monitoring: Air monitoring for airborne concentrations of asbestos fibers shall be conducted by DEP.

    a. All Clearance Air Monitoring results shall meet or be below background ambient air levels or 0.01 f/cc of air (whichever is greater), prior to the breakdown of the Containment. If Clearance Air Monitoring results indicate a fiber count greater than background ambient air levels or 0.01 f/cc of air in any area, the Contractor will be required to re-clean that area. For projects conducted outside of the five boroughs, the clearance and action criteria is less than 0.01 f/cc; of air, or background levels (whichever is greater). Repeated cycles of cleaning and Clearance Air

Monitoring will be performed until a fiber count is achieved that meets or is below background ambient air levels or 0.01 f/cc of air within the area. All costs of re-cleaning and additional Clearance Air Monitoring will be at the Contractor's expense.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleanup: All cleaning Work shall progress from the point most remote from the intakes of the Negative Air Pressure Equipment, towards the intakes of the equipment, as well as from the highest point of the surfaces to be cleaned towards the lowest point of the surfaces. Dry sweeping and using compressed air to cleanup a Regulated Abatement Work Area or a Restricted Area is strictly prohibited. HEPA-filtered vacuums and Wet Cleaning methods shall be used to ensure that these areas remain free of visible dust and debris on a daily basis. In addition, only cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the materials or as approved by DEP, shall be used.

B. Collection, Filtration and Containerization of Wastes: The Contractor shall collect and containerize asbestos waste (solid and liquid), debris, PPE, and Containment materials on a daily basis in accordance with the Asbestos Work Plan. Using chutes to move construction debris or waste (bagged or not bagged) will not be permitted at any time.

1. Prior to containerizing Asbestos-Containing Waste Materials, the wastes shall be “Adequately Wetted,” and wrapped in 6-mil (0.006”) polyethylene sheeting, or double-bagged in 6-mil polyethylene bags. The bags shall be “goose necked” and sealed air tight with duct tape, and each bag (or wrapped item) shall be labeled before being placed in an appropriate container (i.e., dumpster, trailer, or roll-off) for disposal.

2. Corrugated cartons or drums may be used in conjunction with polyethylene bags and sheeting for the disposal of Asbestos-Containing Waste Materials that have sharp-edged components (e.g., nails, screws, or tin sheeting) which may tear the bags or sheeting. The waste within these drums or cartons must be wrapped or double-bagged, and the cartons/drums must be labeled.

3. Wastewater derived from the Asbestos Project shall be collected and filtered through a system with at least a 5.0-micron particle size collection capability. A system containing a series of several filters with progressively smaller pore sizes shall be used to avoid the rapid clogging of the filtration system by large particles. Contaminated filters shall be disposed of as asbestos waste. Filtered wastewater shall be discharged in accordance with all applicable federal, state, and local regulations.

a. Discharging filtered asbestos decontamination water to a DEP Wastewater Treatment Plant (WWTP) will require written permission from the DEP Bureau of Wastewater Treatment (BWT) and the submission of analytical testing results for asbestos to the BWT for review and approval prior to discharge. The disposal requirements for filtered asbestos decontamination water generated on other DEP properties (e.g., drinking water shafts) may be more stringent or prohibited.

C. Storage of Wastes: The Contractor shall store all bagged Asbestos-Containing Waste Materials in DOT-approved container systems (e.g., a roll-off or trailer), as per 49 CFR 178. No container shall be filled in excess of the capacity marked on the container, and all containers shall be lined with 6-mil (0.006") polyethylene sheeting, have a hard top, and shall be lockable. In addition, all containers shall have an intact and legible label affixed to it. No bagged asbestos waste shall be stored in a Regulated Abatement Work Area or decontamination enclosure system for longer than the current Work shift that generated the waste.

1. Non-Asbestos Waste: The Contractor shall store non-Asbestos-Containing Waste Materials separately from Asbestos-Containing Waste Materials, shall provide all non-asbestos waste containers, and shall make all transportation and disposal arrangements for non-Asbestos-Containing Waste Materials in accordance with federal, state, and local regulations.

D. Labeling: The Contractor shall affix warning labels to all asbestos waste disposal bags, wrapped items, and containers (i.e., drums, dumpsters, trailers, or roll-offs). Labels shall comply with the requirements of federal, state, and local regulations. At a minimum, each label on disposal containers/bags/items shall bear the following information in English:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
[Generator Name, Address, and Telephone Number]

E. Final Visual Inspection and Clearance Air Monitoring: The Independent Third-Party Monitor shall not conduct Clearance Air Monitoring until the Regulated Abatement Work Area has been inspected by the Asbestos Handler Supervisor and the Project Monitor has performed the Final Visual Inspection. During this inspection, the Asbestos Handler Supervisor and the Project Monitor shall determine if the following has been achieved: (a) all ACM and Asbestos-Containing Waste Materials have been abated and removed from the area; (b) the area is clean and dry; (c) Critical Barriers and Isolation Barriers are intact; (d) Negative Air Pressure Equipment is turned on and functioning. If any of these items

have not been achieved, the Contractor shall perform the necessary corrective actions to achieve compliance before conducting the Clearance Air Monitoring.

F. Breakdown of the Regulated Abatement Work Area: Critical Barriers shall not be removed and Negative Air Pressure Equipment shall not be turned off until Clearance Air Monitoring results meet the criteria specified in this Section and RCNY Title 15, Chapter 1 or 12 NYCRR 56.

G. Asbestos Project Completion Form/Asbestos Project Conditional Completion: Upon successful completion of an Asbestos Project performed in the five boroughs, a copy of the Asbestos Project Completion Form (ACP-21) or Asbestos Project Conditional Completion Form (ACP-20) issued by the DEP shall be submitted to the Engineer.

H. Disposal of Wastes: Asbestos-Containing Waste Materials shall be disposed of to ensure that containers do not remain on the job site for longer than necessary. Containers that have reached their storage capacity shall not remain on site and transportation arrangements shall be made for their removal.

I. Disposal Documentation: Once all waste profiles have been completed and signed by DEP, the Contractor shall provide DEP with a “Letter of Acceptance” issued by the TSDF indicating that the wastes will be accepted, and a copy of the advance manifest. On the date of disposal, the Contractor shall submit one (1) copy of the completed manifest that has been signed and dated by the initial transporter in accordance with 6 NYCRR 372, 40 CFR 262 and 40 CFR 302, to the DEP for signature as Generator. All manifests and Land Disposal Restrictions (LDRs) must be signed by a DEP employee as per 6 NYCRR 376 and 40 CFR 268, and as described in Section 01 35 45 - Hazardous Materials Control.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. This Section details the requirements for construction and demolition activities affecting materials and structures coated with or containing Lead as shown on Table No. Three (3), attached to Section 01 35 45 – Hazardous Materials Control, specified herein, or required to complete the Work, including all affected coatings identified and impacted by the Work.

B. All Work under this Section shall be performed to minimize the creation of airborne emissions (40 CFR 50); minimize the quantity of hazardous waste generated; protect the health and safety of all site personnel and the welfare of the public; and avoid adverse environmental impacts.

C. In the absence of analytical testing results for a specific painted/coated material, air monitoring and worker Personal Protective Equipment (PPE) requirements, including respiratory protection, shall address the potential presence of Lead.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	10
1.06	Quality Assurance	11
1.07	Submittals	13
1.08	Delivery, Storage, and Handling	19
1.09	Spare Parts, Special Tools, and Supplies	19
1.10	Warranty	19
PART 2	PRODUCTS	19
2.01	Manufacturers	19
2.02	Materials / Equipment	19
2.03	Fabrication / Assembling / Finishes	20
2.04	Source Quality Control / Shop Tests	20
PART 3	EXECUTION	20
3.01	Examination / Preparation	20
3.02	Implementation	22
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	25
3.05	Adjusting / Protection / Cleanup	25

1.02 PAYMENT

A. No separate payment will be made for performing any work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s), or allowance(s) as set forth in Section 01 27 00 – Measurements and Payments.

B. Payment for the disposal of Lead Wastes (with the exception of painted/coated scrap metal) will not be made until a signed copy of the manifest from the Treatment, Storage, and Disposal Facility (TSDF), certifying the amount of Lead Waste delivered is returned with complete chain-of-custody (COC) documentation to DEP.

1.03 RELATED SECTIONS

A. Section 01 35 27 -- Environmental Health and Safety Requirements

B. Section 01 35 45 – Hazardous Materials Control

C. Section 01 41 00 – Regulatory Requirements

D. Section 01 51 11 – Temporary Water and Sanitary Services

E. Section 01 51 12 – Temporary Heat and Ventilation

F. Section 01 51 30 – Temporary Electrical System

G. Section 01 74 20 – Construction Waste Management

H. Section 02 41 10 – Demolition and Removals

I. Section 02 84 05 -- PCB Management

1.04 REFERENCES

A. Definitions

1. Abatement: Any measure or set of measures designed to permanently eliminate Lead Paint hazards (refer to 40 CFR 745.223 for description of what is included). Abatement does not include renovation, remodeling, landscaping, or other activities, when such activities are not designed to permanently eliminate Lead Paint hazards, but instead, are designed to repair, restore, or remodel a given structure or dwelling, even though these activities may incidentally result in a reduction or elimination of Lead Paint hazards. Furthermore, Abatement does not include interim controls, (e.g., the spot removal of a Lead paint/bitumastic coating on a surface in order to perform torch cutting at that location), Operation and Maintenance (O&M) activities, or other measures and activities designed to temporarily reduce Lead Paint hazards.

2. Action Level: Defined by OSHA as individual exposure, without regard to the use of respirators, to a specific airborne concentration of a contaminant expressed in micrograms per cubic meter of air ($\mu g/m^3$) calculated as an 8-hour Time-Weighted Average (TWA). Once an Action Level is met or

exceeded, the Contractor is responsible for meeting specific requirements outlined in the applicable OSHA standard, which may include additional worker Exposure Monitoring, the use of PPE including respiratory protection, the use of Hygiene Facilities, medical surveillance, or training for workers. The following Action Levels are pertinent to the disturbance, removal, construction/demolition, and disposal activities associated with painted/coated materials and structures (as per Section 01 74 20 - Construction Waste Management, Section 02 41 10 - Demolition and Removals):

a. Lead - 30 µg/m^3 per 29 CFR 1926.62.

3. Area Monitoring: Stationary air sampling outside of a Lead Control Area for the purpose of determining compliance with OSHA's Lead in Construction Standard (29 CFR 1926.62), and for the purpose of ensuring that airborne Lead concentrations remain below 30 ug/m^3 outside of the Lead Control Area during all work activities that have the potential to disturb Lead-Containing Materials or Lead Wastes. All Area Monitoring shall follow pertinent NIOSH (Methods 5503, 7048, 7082, 7105, 7300, 7600, 7604, 7900) or ASTM sampling methodologies.

4. Certified Industrial Hygienist (CIH): Refers to an individual employed by the Contractor who is currently certified by the American Board of Industrial Hygiene (ABIH).

5. Competent Person: Defined in the OSHA Lead in Construction Standard (29 CFR 1926.62) as one who is capable of identifying existing and predictable hazards in the surroundings or working conditions, and who has authorization to take prompt corrective measures to eliminate them. Duties of the Competent Person include the following: (a) determining prior to the performance of the Work, whether Lead is present in the workplace; (b) establishing Lead Control Areas and assuring that access to and from those areas is limited to authorized personnel; (c) assuring the adequacy of any employee Exposure Monitoring required by OSHA; (d) assuring that all employees exposed to airborne contaminant levels above Action Levels, Permissible Exposure Limits, or Recommended Exposure Limits wear appropriate PPE, respiratory protection, and are trained in the use of appropriate methods of exposure control for all of the contaminants present; (e) assuring that proper Hygiene Facilities are provided and that workers are trained to use those facilities; (f) assuring that engineering controls specific to the contaminants present are implemented, maintained in proper operating condition, and functioning properly.

6. Decontamination Area: Designated area within the Hygiene Facilities for removing gross contamination from PPE (using a HEPA vacuum), washing away contamination that has accumulated on the skin and hair (using soap and water), removing and disposing/washing of contaminated PPE, and

donning clean clothing that will not potentially contaminate areas outside of a Lead Control Area's Physical Boundary.

7. DOT Hazardous Materials Transportation Training: Training that meets the criteria outlined in 49 CFR 172.704. This training shall include discussions from 49 CFR 171 of the following: (a) hazardous materials tables within 49 CFR 172; (b) material packaging and labeling within 49 CFR 178; (c) shipping papers and placards within 49 CFR 173; (d) material loading and segregation within 49 CFR 173.

8. EPA Lead-Based Paint Supervisor Training: A training course administered by the EPA or approved company - which includes discussions of the following: (a) worker protection and safety; (b) occupant protection; (c) clan-up and clearance; (d) waste disposal; (e) residence and community relations; (f) regulatory aspects; (g) use of X-Ray Fluorescence (XRF) paint analyzers; (h) legal and insurance issues.

9. Exclusion Zone: (See definition of "Lead Control Area").

10. Exposure Monitoring: Personal air sampling performed outside the respirator within the breathing zone of individuals, for the purpose of determining compliance with OSHA's Limits for Air Contaminants Table (29 CFR 1910.1000, Table Z-1) and Lead in Construction Standard (29 CFR 1926.62). Analytical results obtained from Exposure Monitoring will be used to select appropriate respiratory protection and PPE for individuals within a work area. For the purpose of this Section, Exposure Monitoring samples shall be collected from individuals who are representative of each type work task being conducted by the Contractor, and all Exposure Monitoring shall follow pertinent NIOSH or ASTM sampling methodologies.

11. Hazardous Waste Operations (HAZWOPER) Training: Training that meets the criteria outlined in the OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120). A minimum of 24-hour HAZWOPER Training will be required for Abatement work being performed under this Section. However, certain types of work may require 40-hour HAZWOPER Training.

12. High-Efficiency Particulate Air (HEPA) Filter: A filter designed to remove 99.97% of all particles greater than 0.3 micrometers (μm) in diameter. For the purpose of this Section, HEPA vacuum and local exhaust filtration equipment used by the Contractor shall meet the Standard for Safety High-Efficiency, Particulate, Air Filter Units (UL 586) developed by Underwriters Laboratories.

13. Homogenous Materials: Lead-Containing Materials which are similar in appearance, color, texture, and substrate type.

14. Hygiene Facilities: Facilities within the Physical Boundary of a Work area that are set up to prevent cross contamination and are equipped with change

areas and separate storage facilities for PPE and clean clothing. Hygiene Facilities shall include adequately supplied hand washing station(s) (i.e., running water, soap, and clean towels) or shower(s) (hot and cold water that is controllable at the tap, soap, shampoo, and clean towels).

15. Lead: Defined in the OSHA Lead in Construction Standard (29 CFR 1926.62) as metallic Lead, all inorganic Lead compounds, and organic Lead soaps. Excluded from this definition are all other organic Lead compounds.

16. Lead-Based Paint (LBP): A term used by Department of Housing and Urban Development (HUD) and the EPA to define paint or other surface coatings (e.g., glazes) with Lead levels equal to or exceeding 1.0 milligram per square centimeter (1.0 mg/cm^2) in a paint XRF reading, or 0.5% by dry weight (5,000 mg/kg (ppm)) in a paint chip sample. LBP is subject to the requirements set forth in the OSHA Lead in Construction Standard (29 CFR 1926.62).

17. Lead-Containing Material: Any material that contains, or is coated with, a detectable concentration of Lead.

18. Lead-Containing Paint (LCP): A term used to define paint or other surface coatings (e.g., glazes) with any detectable amount of Lead less than 1.0 milligram per square centimeter (1.0 mg/cm^2) in a paint XRF reading, or 0.5% by dry weight (5,000 mg/kg (ppm)) in a paint chip sample. LCP is subject to the requirements set forth in the OSHA Lead in Construction Standard (29 CFR 1926.62).

19. Lead Control Area: The area within the Physical Boundary where worker Hygiene Facilities are located and where all Work activities take place that involve the disturbance of Lead-Containing Materials and Lead Wastes.

20. Lead Paint: A generic term that refers to both LBP and LCP.

21. Lead Waste: Non-specific liquid or solid waste generated during the Abatement, removal, construction/demolition, handling, or cleanup of a Lead-Containing Material.

22. Organic Vapor Cartridge: A NIOSH approved respirator filter typically containing 25 to 40 grams of sorption media such as activated charcoal.

23. OSHA Lead Awareness Training: Annual training that meets the criteria outlined in the OSHA Lead in Construction Standard (29 CFR 1926.62) for individuals that have the potential to be exposed to Lead-Containing Materials or Lead Wastes. This training shall include discussions of the following: (a) current federal, state, and local regulations pertaining to Lead (including 29 CFR 1926.62) and other heavy metals that may be disturbed during the Work; (b) the health effects of Lead and other heavy metal exposure; (c) state-of-the-art work practices, engineering controls, and procedures for Abatement, removal, construction/demolition, materials handling, waste management, and housekeeping activities that involve

Lead-Containing Materials and Lead Wastes; (d) the use and maintenance of PPE and the use and maintenance of respirators in accordance with 29 CFR 1910.134; (e) medical surveillance programs and the medical removal protection program; (f) requirements regarding warning signs, labeling, and Safety Data Sheets (SDSs) in accordance with 29 CFR 1910.1200; (g) responsibilities of the Competent Person.

24. OSHA Lead in Construction Standard (29 CFR 1926.62): A federal standard that applies to all construction work where an employee may be occupationally exposed to Lead. In this standard, "construction work" is defined as work for construction, alteration, or repair, including painting and decorating. It also includes, but is not limited to, the following: (a) the demolition or salvage of structures where Lead or materials containing Lead are present; (b) the removal or encapsulation of materials containing Lead; (c) new construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain Lead, or materials containing Lead; (d) the installation of products containing Lead; (e) Lead contamination/emergency cleanup; (f) the transportation, disposal, storage, or containment of Lead or materials containing Lead on the site or location at which construction activities are performed; (g) maintenance operations associated with any of the construction activities described in this definition.

25. OSHA Monitoring: (See definition of "Exposure Monitoring").

26. P-100 Filter: (See definition of: "High-Efficiency Particulate Air (HEPA) Filter").

27. Perimeter Monitoring: (See definition of "Area Monitoring").

28. Permissible Exposure Limit (PEL): Defined by OSHA as employee exposure, without regard to the use of respirators, to a specific airborne concentration of a contaminant expressed in micrograms per cubic meter of air ($\mu g/m^3$) calculated as an 8-hour TWA. Once a PEL is met or exceeded for a particular contaminant, the Contractor is responsible for meeting specific requirements outlined in the applicable OSHA standard, which may include worker Exposure Monitoring, the use of PPE including respiratory protection, the use of Hygiene Facilities, medical surveillance, or training for workers. The following PELs are pertinent to removal, demolition, and disposal activities associated with Lead-Containing Materials and Lead Wastes:

    a. Lead - 50 $\mu g/m^3$ per 29 CFR 1926.62.

29. Personal Monitoring: (See definition of "Exposure Monitoring").

30. Physical Boundary: A physical barrier designated with ropes, "caution tape," or a partition that surrounds a work area in order to limit the entry of unauthorized personnel and delineate "clean areas" from areas that may meet or exceed an Action Level, PEL, or REL.

31. Recommended Exposure Limit (REL): An exposure limit recommended by the NIOSH that can be expressed as a TWA, Ceiling Limit, or Short-Term Exposure Limit (STEL). Once an REL is met or exceeded for a particular contaminant, the Contractor is responsible for ensuring that workers receive appropriate Exposure Monitoring, PPE, including respiratory protection, Hygiene Facilities, medical surveillance, and training.

32. Regulated Area: (See definition of "Lead Control Area").

33. Resource Conservation and Recovery Act (RCRA) Training: Training that meets the criteria outlined in 40 CFR 265.16. This training shall include Site-specific discussions of the following: (a) hazardous waste identification; (b) waste storage container use and labeling; (c) waste storage area management; (d) personal health and safety, including fire safety; (e) manifesting and the off-site transportation of wastes; (f) procedures for using, inspecting, repairing, and replacing emergency equipment and monitoring equipment; (g) procedures for communicating with other employees and outside emergency response personnel; (h) responses to fires or explosions; (i) responses to leaks, spills, and potential groundwater contamination incidents ; (j) the shutdown of operations.

34. Time Weighted Average (TWA): The average time over a given work period (e.g., an 8-hour workday) of a person's exposure to a chemical or agent. The average is determined by sampling for the chemical or agent throughout the time period.

35. Trigger Activities: Certain activities that involve a disturbance of Lead-Containing Materials or Lead Wastes. Depending upon whether the performance of these activities exceeds an Action Level, PEL, or REL, the requirements may include additional worker Exposure Monitoring, the use of PPE including respiratory protection, the use of Hygiene Facilities, medical surveillance, or training for workers. Examples of Trigger Activities include, but are not limited to, the following: abrasive blasting, welding, torch cutting/burning, heat gun usage, needle gunning/scaling, rivet busting, using a roto peen, mechanical sanding/grinding, using mechanical shears, hand scraping/sanding, chemical stripping, and the manual demolition of Lead-Containing Materials.

36. X-Ray Fluorescence (XRF): An analytical method that can be used in the field for determining the Lead content of paints/coatings on a building component or material surface.

B. Reference Standards

1. The Contractor shall comply with all applicable regulations, standards, and guidelines of federal, state, and local environmental and occupational safety and health agencies regarding Lead-Containing Materials and Lead Wastes. These regulations, standards, and guidelines include, but are not limited to the following:

a. United States (U.S.) Department of Transportation (DOT):

1) 49 CFR 171 - General Information, Regulations, and Definitions;

2) 49 CFR 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements;

3) 49 CFR 173 – Shippers: General Requirements for Shipments and Packaging's;

4) 49 CFR 178 – Specifications for Packaging.

b. United States Environmental Protection Agency (EPA):

1) 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards;

2) 40 CFR 116 – Designation of Hazardous Substances;

3) 40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances;

4) 40 CFR 260 – Hazardous Waste Management Systems: General;

5) 40 CFR 261 – Identification and Listing of Hazardous Waste;

6) 40 CFR 262 – Standards Applicable to Generators of Hazardous Waste;

7) 40 CFR 263 – Standards Applicable to Transporters of Hazardous Waste;

8) 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities;

9) 40 CFR 265 – Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities;

10) 40 CFR 268 – Land Disposal Restrictions;

11) 40 CFR 302 – Designation, Reportable Quantities, and Notification;

12) 40 CFR 745 – Lead-Based Paint Poisoning Prevention in Certain Residential Structures.

c. National Institute for Occupational Safety and Health (NIOSH):

1) Method 5503 – Polychlorobiphenyls;

2) Method 7082 – Lead by FAAS;

3) Method 7105 – Lead by GFAAS;

4) Method 7300 – Elements by ICP;

5) NIOSH Pocket Guide (NPG) to Chemical Hazards.

d. New York City Department of Environmental Protection (DEP):

1) Environmental Health and Safety Policies and Procedures – Vol. III, Lead Management;

2) Environmental Health and Safety Policies and Procedures – Vol. IV, Hazardous Waste Management;

3) Environmental Health and Safety Policies and Procedures – Vol. III, EHS Reporting and Investigation

4) RCNY Title 15, Chapter 19 – Discharges of Wastewater and Other Materials to Public Sewers.

e. New York State Department of Environmental Conservation (NYSDEC):

1) 6 NYCRR 364 – Waste Transporter Permits;

2) 6 NYCRR 370 – Hazardous Waste Management Regulations;

3) 6 NYCRR 371 – Identification and Listing of Hazardous Waste;

4) 6 NYCRR 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities;

5) 6 NYCRR 373 – Hazardous Waste Management Facilities;

6) 6 NYCRR 376 – Land Disposal Restrictions.

f. Occupational Safety and Health Administration (OSHA):

1) 29 CFR 1910 – Occupational Safety and Health Standards;

2) 29 CFR 1910.28 – Safety Requirements for Scaffolding;

3) 29 CFR 1910.120 – Hazardous Waste Operations and Emergency Response;

4) 29 CFR 1910.134 – Respiratory Protection Standard;

5) 29 CFR 1910.1200 - Hazard Communication Standard;

6) 29 CFR 1926 – Safety and Health Regulations for Construction;

7) 29 CFR 1926.62 – Lead in Construction Standard;

g. Society for Protective Coatings (SSPC):

1) SSPC Guide 6, Guide for Containing Debris Generated During Paint Removal Operations;

2) SSPC Guide 7, Guide for the Disposal of Lead-Contaminated Surface Preparation Debris;

3) SSPC SP COM, Surface Preparation Commentary for Steel and Concrete Substrates;

4) SSPC SP 1, Solvent Cleaning;

5) SSPC SP 2, Hand Tool Cleaning;

6) SSPC SP 3, Power Tool Cleaning;

7) SSPC SP 11, Power Tool Cleaning to Bare Metal;

8) SSPC SP 13/ NACE No.6, Surface Preparation of Concrete;

9) SSPC SP 15, Commercial Grade Power Tool Cleaning.

h. Underwriters Laboratories, Inc. (UL):

1) UL 586 – Standard for Safety High Efficiency, Particulate, Air Filter Units.

1.05 DESCRIPTION

A. Commencement of Work: Five (5) business days prior to the proposed start of the Work required under this Section at each separate location, the Contractor shall notify the Engineer and the onsite EHS staff. No Work may proceed at any location until authorized by the Engineer.

B. The Contractor shall coordinate any required equipment shutdowns with the Engineer prior to starting the Work.

C. Access Restrictions: The Contractor shall inform the Engineer of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed work) and provide estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall notify other contractors in advance of the disturbance, Abatement, spot removal, construction/demolition, and disposal Work included herein, to provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.

D. Unexpected Entry into a Lead Control Area: In the event that DEP personnel must enter a Lead Control Area for emergency reasons, the Contractor shall immediately stop work and cleanup any loose debris, so as to permit the safe entry by DEP personnel. Any disturbance of paints/coatings, dusts, materials, or wastes that may potentially generate airborne concentrations of contaminants equal to or above an

OSHA Action Level shall not proceed until all DEP personnel have exited from the Lead Control Area.

E. Meetings: In addition to the pre-construction meeting and Site walk-through, other meetings may be required or may be requested by the Engineer, including briefings with Site operations personnel. Written documentation (i.e., "minutes") of all meetings shall be generated by the Contractor, and copies shall be provided to DEP within three (3) business days following each meeting.

1.06 QUALITY ASSURANCE

A. Scheduling: The Contractor shall coordinate and schedule all phases of the Work to be performed under this Section with DEP, subcontractors, material suppliers, and other parties as necessary to ensure the proper execution of the Work.

B. Compliance: In addition to the detailed requirements of this Section and DEP EHS Policies and Procedures, the Contractor shall comply with all applicable regulations of federal, state, and local authorities pertaining to the disturbance, Abatement, removal, construction/demolition, handling, storage, transportation, and disposal of Lead-Containing Materials and Lead Wastes. All matters regarding the interpretation of any regulations, standards, or policies shall be submitted to the Engineer for resolution before starting the Work. Where the requirements of this Section, DEP EHS Policies and Procedures, or federal, state, or local regulations conflict or vary, the most stringent requirements or regulations shall apply.

C. Rejection of Non-Complying Items: DEP reserves the right to reject Contractor materials/tools/submittal items that are deemed inappropriate or unacceptable by the Engineer or DEP. Submittal items that may be deemed inappropriate or unacceptable include proposed TSDFs, vendors, or subcontractors with previous regulatory citations/violations. DEP further reserves the right, and without prejudice to other recourse, to accept non-complying items subject to an adjustment in the Contract amount, as approved by DEP.

D. Suspect Material Characterization: To classify a paint or coating as Lead-containing, a paint chip/coating sample or an XRF reading must be collected. The bulk samples shall be sent to an analytical laboratory meeting the requirements of this Section.

1. Suspect Lead: Although there are no certification requirements pertaining to an individual that collects paint chip/coating samples in an industrial or commercial setting, this Section requires paint chip/coating sampling to be performed by a Lead Sampler.

E. Qualifications:

1. The Paint Removal Company shall have successfully completed at least two (2) projects of comparable scope and methodologies, and shall document the following: (a) the name, address, and phone number of each facility where the Work was performed; (b) the volume and type of each material that was abated/removed; (c) the specific methods of Abatement/removal

used (including the tools, technologies, and engineering controls employed).

2. Competent Person:

   a. The Competent Person shall have successfully completed:

      1) EPA Lead-Based Paint Supervisor Training Certification (current) in accordance with 40 CFR 745.225 (b)(7)(vi); and

      2) OSHA Lead Awareness Training (annual); and

      3) 24-hr HAZWOPER Training.

   b. The Competent Person shall have a minimum of two (2) years' experience on projects involving Lead and has served as the Competent Person on at least three (3) projects of comparable scope and methodologies to the work being conducted under this Section.

3. Waste Manager:

   a. The Waste Manager shall have successfully completed:

      1) DOT Hazardous Materials Transportation Training; and

      2) RCRA Training - Each training course shall have been completed within the past year in the form of either an initial course or a refresher course.; and

      3) 24-hr HAZWOPER Training; and

      4) OSHA Lead Awareness Training (annual).

   b. The Waste Manager shall have a minimum of two (2) years' experience on projects involving hazardous wastes (including Lead). It is acceptable for an individual who meets the criteria of the Competent Person, to also serve as the Waste Manager for this Contract as long as the individual fulfills all of the requirements of this paragraph.

4. Lead Worker:

   a. Lead Workers shall have successfully completed:

      1) OSHA Lead Awareness Training (annual) as defined in this Section; and

      2) EPA-certified Lead Worker Training for all Lead Abatement activities (current). OSHA Lead Awareness Training satisfies the training requirement for other Lead removal activities (e.g., spot removal and demolition work).

   b. Each Lead Worker shall have a minimum of one (1) year of experience on projects involving Lead and have worked on at least

three (3) projects of comparable scope and methodologies to the work being conducted under this Section.

5. Lead Sampler:

   a. Lead Sampler shall have successfully completed:

      1) OSHA Lead Awareness Training (annual) as defined in this Section; and

      2) EPA Certified Lead Inspector course or EPA-certified Risk Assessor course (current).

   b. The Lead Sampler shall have documented experience in collecting paint chip samples.

   c. The qualifications of the Lead Sampler must be approved by the Engineer prior to sample/reading collection.

6. Air Monitor:

   a. The Air Monitor shall have successfully completed:

      1) OSHA Lead Awareness Training (annual).

   b. The Air Monitor shall have a minimum of two (2) years' experience in conducting Area Monitoring and Exposure Monitoring on projects involving hazardous wastes (including Lead). It is acceptable for an individual who meets the criteria of the Competent Person or Waste Manager to also serve as the Air Monitor for this Contract as long as the individual satisfies all of the requirements of this paragraph.

1.07 SUBMITTALS

A. Thirty (30) business days prior to the Work of this Section or as directed by the Engineer, the Contractor shall submit the following to the Engineer:

1. Lead Inspection and Sampling Plan: The Contractor shall provide a Lead Inspection and Sampling Plan to identify suspect Lead-Containing Materials and collect confirmatory samples, as appropriate during the inspection. The Lead Inspection and Sampling Plan shall include at a minimum:

   a. At a minimum, the inspection shall be performed by an Environmental Professional, who has current OSHA Lead Awareness and EPA Lead Inspector Training, as applicable to the location of the work, and has performed inspection work on at least three (3) projects of comparable scope.

   b. Credentials of the laboratory providing sample analysis, including current certification by the New York State Department of Health's (NYSDOH) Environmental Laboratory Approval Program (ELAP) and by the American Industrial Hygiene Association (AIHA).

c. Sample collection, analysis and reporting protocol.

d. Health and safety protocol (Job Hazard Analysis) for all investigative activities.

2. Lead Inspection Report: The Contractor shall provide a Lead Inspection Report prepared by the Environmental Professional summarizing the results of all inspection activities, and as applicable, a sampling narrative, laboratory data packages and inventory, including photographs, of all identified suspect and confirmed Lead-Containing Materials.

3. Lead Management Plan(s): Work requiring a Lead Management Plan includes Lead Paint Abatement and Lead Paint spot removal activities. The Lead Management Plan shall be signed and dated by a CIH meeting the definition in this Section.

a. If the Lead-Containing Materials or Lead Wastes that will be disturbed also contain PCBs, it is acceptable to integrate the Lead Management Plan elements into the relevant PCB Management Plan (required under Section 02 84 05 - PCB Management). The Lead Management Plan shall include the following elements:

1) Lead Control:

a) Drawings showing the location and details of the following: (a) each Lead Control Area; (b) each Hygiene Facility; (c) proposed electrical hookups; (d) proposed water hookups: (e) each waste storage area: (f) restroom areas; (g) areas designated for eating, drinking, and smoking;

b) Section on the interfacing of trades (other Contractors) and the sequencing of Lead-Related Work;

c) Section on the collection, handling procedures, and disposal of Lead-Containing Materials and Lead Wastes (including the collection, filtering, and disposal of wastewater);

d) Section on the procedures and methodologies that will be used to conduct Exposure Monitoring and Area Monitoring for particulates. Also, provide the name and qualifications (i.e., training and experience documentation) of the Air Monitor who will be responsible for conducting the air monitoring activities. The Air Monitor shall at a minimum, satisfy the qualification requirements set forth in this Section;

e) Section on housekeeping procedures to be used for maintaining clean work areas and clean Hygiene Facilities;

f) Section on the specific methods and procedures of emissions control that will be used to ensure that airborne contaminant levels do not meet or exceed an OSHA Action Level outside of each Lead Control Area. It should be noted that even after paint/coating removal, DEP has found that demolition activities (e.g., torch-cutting abated steel) still have the potential to generate elevated airborne levels of Lead. Therefore, the Contractor shall provide engineering controls to capture potential Lead dusts or fumes emitted during demolition work that involves the cutting or burning of steel structures that have already been abated;

g) Task Analysis: Each Task Analysis shall include, but is not limited to, the following information: (a) the type of Work activity; (b) the tools/equipment that will be used and their respective decontamination procedures; (c) operation and maintenance practices and procedures that will be used for the tools/equipment; (d) the types of Lead-Containing Materials that may be disturbed or Lead Wastes that may be generated when performing the activity; (e) the engineering controls that will be used to control the spread of contamination during the activity; (f) the proposed crew size for the activity and individual employee responsibilities during the activity; (g) housekeeping procedures that will be used during the activity; (h) PPE and proposed respiratory protection that will be used for the activity;

2) Equipment and Supplies: Identify the equipment and supplies that will be used to perform the Work;

3) Rental Equipment Notification: If rental equipment is to be used during the Work, the Contractor shall notify the rental agency in writing concerning the intended use of the equipment;

4) SDSs: Provide SDSs for all chemical products (including chemical stripping products) to be used for the Work;

5) The name and qualifications (i.e., experience and training documentation) of the Competent Person, who shall satisfy

the qualification requirements set forth in this Section and be present whenever Work of this Section is being performed.

b. Waste Management:

1) The identification of Lead-Containing Materials, Lead Wastes, and hazardous wastes (as defined in 40 CFR 116, 40 CFR 260, 40 CFR 261, 6 NYCRR 370 and 6 NYCRR 371) associated with the Work;

2) The estimated quantity of each waste stream (regulated and non-regulated) that will be generated and disposed of/recycled as per 40 CFR 302;

3) The name, address, 24-hour phone number, and current permit documentation for each recycling facility or TSDF indicating that the facility is approved by federal, state, and local regulatory agencies to receive Lead-Containing Materials and Lead Wastes, and that there are no outstanding violations or enforcement actions;

4) Current 6 NYCRR 364 and 40 CFR 263 permit documentation for the waste transporter that will transport Lead-Containing Materials and Lead Wastes from the Work Site to the TSDF;

5) Spill prevention, containment, and cleanup contingency measures to be followed during a suspected Lead emissions/bulk material release or emergency situation;

6) Section on the on-site handling, storage, removal, and disposal of waste materials, including but not limited to, the following: (a) secondary containment system for each drum storage area; (b) description of the waste storage areas; (c) the methods and procedures that will be used to collect and containerize wastes on a daily basis; (d) the types of containers; (e) the submittal of weekly regulated waste inspection and inventory records;

7) The name and qualifications (i.e., experience and training documentation) of the Waste Manager.

c. A detailed schedule for the implementation of the Lead Management Plan elements, including start and completion dates that allow for adequate time for cleanup, inspections, and air monitoring activities.

d. Medical Surveillance: For all activities within a Lead Control Area, each worker shall have: (a) an initial blood testing (including Zinc Protoporphyrin (ZPP) testing), and have a Blood Lead Level (BLL) below 35 micrograms per deciliter (μg/dl)(if the worker's BLL is in

excess of 35 µg/dl, the worker shall show medical approval for this Work); (b) a medical exam, including a Pulmonary Function Test (PFT) within the past year; (c) written medical clearance within the past year, by a licensed health care professional, to wear a respirator; (d) a qualitative/quantitative respirator fit-test for the specified respirator within the past year.

e. Employee Documentation: For all activities that take place within a Lead Control Area, each worker shall: (a) have written proof of resumes and training (e.g., certificates) for Lead Workers, Competent Persons, Waste Managers, and Air Monitors; (b) dates and written proof of initial medical surveillance by the Contractor or other employer within the past year, and proof that the employee is currently participating in the employer's ongoing medical surveillance program in accordance with this Section; (c) dates and written proof of respiratory clearance and a medical exam; (d) dates and written proof of a respirator fit-test.

f. A current (i.e., within the last month) signed and notarized statement disclosing all of the Contractor's or subcontractor's OSHA, EPA, and DOT citations/violations on projects involving Lead within the past three (3) years.

4. Analytical Laboratory Qualifications for Analyzing Suspect Lead-Containing Materials and Lead Wastes: Submit the name, address, and telephone number of each analytical laboratory selected to perform the analyses of waste samples (solid and liquid), air samples collected for Area Monitoring and Exposure Monitoring purposes, and paint/coating samples collected to classify building components, including copies of current AIHA and ELAP certificates, including dates of accreditation/reaccreditation. .

B. Field Reports and Recordkeeping: The Contractor shall maintain and provide the following documentation:

1. Air Monitoring Documentation: All air monitoring results, including COC, and daily air monitoring reports shall be provided to DEP within 24-hours from the date the samples are collected.

a. Each signed daily air monitoring report shall include, but not be limited to, the following information: (a) sample "start" and "stop" times; (b) flow rates (initial and final) for each sample; (c) the total volume of air collected for each sample; (d) sample location descriptions/sample location drawings/names of individuals being sampled; (e) types (i.e., makes and models) of sampling equipment used; (f) types of sample media (i.e., filters and cassettes) used; (g) the most recent calibration dates, along with the calibration results, for the sampling equipment used; (h) the name of the Air Monitor that conducted the air monitoring; (i) dates that the air monitoring

was conducted; (j) work tasks being performed during the air monitoring; (k) unique sample numbers used to identify each sample.

2. Waste Documentation: Completed and signed waste manifests from TSDFs shall be provided to DEP no later than thirty (30) days after disposal. In addition, on-site waste storage areas shall be inspected weekly by the Waste Manager.

   a. Each waste storage area inspection shall be coordinated with the Engineer, documented in the form of a written signed report, and shall be provided to DEP within 24-hours of the inspection date. These reports shall include, but not be limited to, the following information: (a) the name of the inspector; (b) descriptions of waste streams; (c) waste container type, physical condition, and quantity; (d) proper label type; (e) secondary containment system; (f) storage area security method to prevent any unauthorized entry; (g) the presence of any containers that violate RCRA generator storage time limitations, as defined in 40 CFR 262.

   b. In addition to performing weekly waste storage area inspections, the Waste Manager shall also maintain an ongoing waste inventory, including: (a) specific dates that each waste container was added/removed from the waste storage area; (b) the full name (printed) and signature of the individual responsible for adding/removing each waste container from the waste storage area.

3. Lead Control Area Inspection Documentation: Lead Control Areas shall be inspected daily by the Competent Person.

   a. Each daily Lead Control Area inspection shall be documented in the form of a signed written report. All reports shall be provided to DEP no later than 24-hours after the inspection is completed. The content of these reports shall include : (a) the types of Work being performed; (b) the names of the Lead Workers, Competent Person, Waste Manager, and Air Monitor on site, including company name; (c) the types of air monitoring and the number of samples being collected; (d) any non-compliance issues observed, including the corrective actions that were taken to achieve compliance.

4. Contractor Project Record: The Contractor's Competent Person shall maintain a project record at the Work Site that shall be made available to the Engineer or DEP for review at any time, and shall be submitted to DEP within 24-hours after the completion of the Work.

   a. At a minimum, the Contractor project record shall contain the following information: (a) copies of training certificates for all individuals involved with the Work; (b) copies of all air monitoring results generated during the Work; (c) copies of all available paint

chip/coating sample analytical data and XRF analyzer data, as well as paint/coating survey reports related to the Work; (d) copies of all daily sign-in sheets; (e) a list of emergency phone numbers, including the local fire department, local police department, nearest hospital, as well as phone numbers for the Engineer and DEP personnel responsible for administering the Work; (f) a copy of the OSHA Lead in Construction Standard (29 CFR 1926.62); (g) copies of all SDSs pertaining to all chemicals being used during the Work; (h) a copy of the Contractor's Lead Management Plan; (i) copies of all daily Lead Control Area inspection records; (j) copies of all weekly waste storage area inspection records; (k) a copy of the waste inventory; and (l) a copy of the Contractor's Hazard Communication (HAZCOM) program.

5. Daily Sign-In Sheets: The Contractor shall generate daily sign-in sheets for all individuals entering and exiting each Lead Control Area for the duration of the Work. The daily sign-in sheets shall be maintained by the Competent Person and shall be made available to the Engineer or DEP for review at any time during the Work. All daily sign-in sheets shall be submitted to DEP within 24-hours after the completion of the Work.

   a. At a minimum, each daily sign-in sheet shall include: (a) the individual's printed name and signature; (b) company name; (c) the time of entry and exit from each Lead Control Area.

6. HAZCOM Program: The Contractor's HAZCOM program shall be made available to the Engineer or DEP for review at any time during the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Respirators: The Contractor shall select respirators approved by the NIOSH for use in areas where paints/coatings, dusts, materials, or wastes containing contaminants may be disturbed. At a minimum, the Contractor shall provide each individual with

a half-face, negative pressure, air purifying respirator equipped with HEPA/P-100 Filter cartridges until Exposure Monitoring results indicate that respiratory protection can be modified. The Contractor's CIH shall make all determinations regarding respiratory protection modifications that will be implemented for the Work. All modifications shall be in accordance with the OSHA Lead in Construction Standard (29 CFR 1926.62).

B. PPE: The Contractor shall provide personnel who have a potential to be exposed to materials or wastes containing contaminants, with appropriate PPE as prescribed by the Contractor's CIH.

C. HEPA Filters: HEPA/P-100 Filters used in vacuuming equipment, power tools, and local exhaust equipment must meet or exceed any manufacturer's specifications and recommendations, as well as specifications presented in the Standard for Safety High Efficiency, Particulate, Air Filter Units (UL 586).

D. Waste Containers: Containers for the storage of all wastes shall be DOT-approved, and shall be provided by the Contractor.

E. Abrasives: Mechanical paint/coating removal equipment shall not use any products containing crystalline silica, and the equipment shall not utilize any non-recoverable materials or any cutting materials which introduce toxic or hazardous materials into the environment.

F. Chemical Strippers: The Contractor shall utilize an environmentally safe chemical paint stripping system, with demonstrated suitability and efficiency in preparing cast-in-place concrete, cement, and plaster surfaces that are free of any visible residues of paints/coatings. The system shall include non-alkaline or alkaline strippers that provide the lowest possible level of toxicity consistent with the types of paints/coatings to be removed. Neutralization products and procedures shall be provided for all alkaline stripping systems, no stripping system shall contain methylene chloride, and the stripping system shall be low in volatile organic compounds (VOCs).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Hygiene Facilities: The Contractor shall provide functional Hygiene Facilities as defined in this Section that are appropriate for the types of Work to be performed under this Section. The Contractor shall ensure that employees do not leave a Lead Control Area wearing any potentially contaminated PPE. Using compressed air to

dislodge dust from clothing/PPE shall be strictly prohibited. The Contractor shall collect, test, and properly dispose of all wastewater generated from Hygiene Facilities.

1. Handwash Stations: The Contractor shall provide functioning handwash stations on all projects that disturb Lead-Containing Materials or Lead Wastes. Handwash stations shall have running water at the tap, clean towels, and soap per 29 CFR 1926.51. Substituting "hand wipes" in place of soap and running water will not be acceptable.

2. Showers: The Contractor shall provide shower facilities in accordance with 29 CFR 1926.62, for use by employees whose airborne exposure to Lead is above the PEL. When shower facilities are necessary, employees are required to shower at the end of the work shift each day prior to leaving the Lead Control Area that they are working in.

B. Utilities: The temporary use of any on-site utilities shall be subject to the approval of DEP. The Contractor shall furnish all water, hoses and water filtration devices needed for the Work as per Section 01 51 11 - Temporary Water and Sanitary Services; as well as any temporary electrical hookups and temporary lighting to the Lead Control Area as per Section 01 51 30 - Temporary Electrical System. All temporary lighting and temporary electrical service to a Lead Control Area shall be provided by the Contractor and shall be in weather-proof enclosures and be ground fault protected. Also, the Contractor shall supply all heating and ventilation equipment needed for the Work as per Section 01 51 12 - Temporary Heat and Ventilation.

C. Signs: The Contractor shall post conspicuous warning signs at all approaches to work areas and waste storage areas. Signs shall comply with federal, state, and local regulations, including the requirements of OSHA. Signs shall not be removed until all Abatement, removal, and construction/demolition activities have been completed. At a minimum, each sign shall bear the following information in English and the predominant language that is spoken by the Contractor's employees if English is not spoken:

WARNING

LEAD WORK AREA

POISON

NO SMOKING, EATING OR DRINKING

1. Each sign shall be appropriately modified to include additional warnings for other contaminants that are identified during Exposure Monitoring.

D. Physical Boundary Delineation: The Contractor shall clearly delineate each Work area and waste storage area with a Physical Boundary as defined in this Section.

E. Work Area Preparation: The Contractor shall utilize HEPA-filtered vacuums, and wet methods during the initial cleaning of each work area. Prior to removal from each work area, all movable objects and mounted objects that can be removed shall be pre-cleaned using HEPA-vacuums and wet methods. Fixed objects that must remain within each work area shall be pre-cleaned using HEPA vacuums and wet methods, and subsequently covered with 6-mil polyethylene sheeting.

3.02 IMPLEMENTATION

A. Bulk Removal

1. Protection of Existing Work to Remain: All Work involving the disturbance of Lead-Containing Materials or Lead Wastes must be conducted without damage to, or contamination of equipment or surfaces within the work areas or other areas adjacent to the work areas. All such damage or contamination shall be immediately corrected and cleaned up by the Contractor at the Contractor's expense.

2. Prohibited Activities: Contractors shall not conduct activities that are prohibited by OSHA and EPA regulations. The following activities are prohibited, regardless of whether they are conducted subject to an exposure assessment and written compliance program: (a) burning-off paints/coatings; (b) using heat guns operating above 1100oF; (c) dry machine sanding, grinding, or blasting paint without a HEPA vacuum exhaust tool; (d) uncontained hydroblasting or high-pressure washing; (e) welding painted/coated surfaces unless the paint/coating is removed at least 4-inches from area of heat application (per 29 CFR 1926.345(c)(1)), and local exhaust ventilation is used.

3. Test Patches: Prior to choosing the paint removal method(s) for paints/coatings, the Contractor shall perform test patches on surfaces subject to Abatement, to determine if the method(s) meet the requirements of this Section.

4. Mechanical Removal Equipment: When removing paints/coatings from metal surfaces, the paints/coatings must be removed to the extent that only the bare metal remains (i.e., no mill scale remains) as per SSPC SP 2, 3, 11, 15 and COM, as applicable. In the case of substrates other than metal (e.g., concrete, brick, and block), paints/coatings shall be removed from the surface of the substrate as per SSPC SP 13 and SSPC SP COM, as applicable, and managed in accordance with SSPC Guide 7. Acceptance of the Work shall be contingent upon inspection of the substrate surfaces by the Engineer and must demonstrate the absence of residual paint/coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and tools meeting the performance specifications outlined below:

a. Contractor shall utilize a vacuum-assisted power tool system with demonstrated suitability and efficiency in preparing metal surfaces

as per SSPC Guide 6 and SSPC SP 11, and with demonstrated effectiveness in maintaining Lead emissions below OSHA exposure limits during the disturbance of paints/coatings. Such systems may include dustless needle guns, dustless roto peens, and dustless right-angle grinders, all of which capture dust and debris at the cutting tool edge and transport the material under vacuum conditions to an air-tight disposal container. Dustless needle guns shall only be utilized on metal surfaces.

b. The vacuum-assisted power tool system shall also be designed to permit the removal and replacement of collection containers under negative pressure in order to prevent the release of dusts. The system shall be equipped with an automatic “shut-off” in the event of vacuum failure.

c. Abrasive/recovery tools shall be monitored at all times by a device capable of determining recovery at the face of each tool, and capable of automatically disabling the tool in the event that recovery levels are insufficient. The monitor, at a minimum, shall have the following features: (a) a remote warning light; (b) an adjustable recovery set point; (c) automatic equipment disabling capabilities; (d) a sensing range of 0 - 5 pounds per square inch (psi); (e) solid state photohelic instrumentation; (f) remote sensing at the face of the tool.

d. The safe recovery point shall be calibrated each day before start-up, or each time a new tool or vacuum source is used. All manufacturer recommendations shall be followed with respect to the set up and use of the monitor, and the manufacturer's operations manual shall be kept on site at all times. A daily log shall be maintained by the Contractor, identifying all calibrations of recovery levels, as well as any “down time” as a result of insufficient recovery levels.

e. The cutting head of the vacuum-assisted power tool system that is used on flat surfaces shall be capable of cutting to within 1-1/2" of any inside corner, molding, or edge, and may include dustless roto peens or dustless needle guns. Tools for corners and moldings shall be specifically designed for that purpose, and conform to all inside corners, outside corners, curved, flat, and angled surfaces that are to be abated under this Section. These tools shall also maintain vacuum control at the work surface/cutting head interface at all times. HEPA vacuum-shrouded needle guns may be used for non-flat surfaces in accordance with manufacturer recommendations. Vacuum-assisted finishing tools, such as right angle grinders, may be used to achieve the SSPC SP 11 standard, but may not be used for primary removal.

f. Vacuum-assisted power tool systems meeting all of the specifications outlined herein, may be used pending the submittal of

all required performance documentation, and their acceptance by the Engineer. Any tools which do not meet all of the specifications outlined herein, shall be removed from the project Site immediately, and shall not be used for the Work to be performed under this Section.

5. Chemical Strippers: Acceptance of the Work shall be contingent upon inspection of the abated substrate surfaces by the Engineer, and must demonstrate the absence of residual paint/coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and paint stripping systems meeting the performance specifications outlined below:

   a. The Contractor shall utilize a chemical paint stripping system with a demonstrated effectiveness in maintaining Lead emissions below OSHA exposure limits during the disturbance of paints/coatings. The Contractor shall utilize a mechanical ventilation system during the Work that exhausts away from occupied areas. The application of all paint stripping systems shall be in accordance with manufacturer recommendations and SSPC SP 1. Debris shall be managed in accordance with SSPC Guide 7.

   b. The Contractor should note that more than one product may be required to strip LCP/coatings. The use of multiple products shall be in accordance with Work practices approved by the individual manufacturer of each chemical paint stripping compound.

   c. All chemical paint stripping products shall be presented to the Engineer for approval prior to the start of any Work to be performed under this Section. Also, the manufacturer's labels on each container shall be intact and legible.

   d. Chemical paint stripping systems may be used pending the submittal of all required performance documentation, and its acceptance by the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Air Monitoring

1. Air monitoring for airborne concentrations of Lead shall be conducted by the Air Monitor in accordance with OSHA and as defined in this Section.

   a. Exposure Monitoring: For Work involving the disturbance of any detectable concentration of Lead, the Contractor shall collect personal air samples from employees who are anticipated to have the greatest risk of exposure, as determined by the Contractor's CIH or Competent Person. Personal air samples shall be collected during every work shift from at least one (1) employee that is representative of each type of work task that is being performed. Each personal air

sample shall "run" for the employee's entire work shift to ensure that enough volume (of air) is collected and an accurate 8-hour TWA can be calculated. Documentation regarding the sample numbers, specific shift when the sampling was conducted, the work tasks that were sampled, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

2. Area Monitoring: The Contractor shall collect a minimum of two (2) area air samples outside of each Lead Control Area on a daily basis for the duration of the Abatement, removal, or construction/demolition Work, as well as any other Work involving the disturbance of Lead-Containing Materials or Lead Wastes. During sampling activities, all air sample filter cassettes shall be positioned approximately five to six feet above the ground (to simulate an individual's breathing zone), and shall not be placed immediately adjacent to obstructions (e.g., walls or columns) which may restrict the flow of air to the filter cassettes. Each air sample shall be analyzed for all contaminants identified during the exposure assessment. If area air monitoring indicates an emission level in excess of an OSHA Action Level outside of a Lead Control Area, all Work in that area shall be stopped immediately. The Contractor shall then take immediate corrective actions to reduce emission levels to below the Action Level(s), and the Contractor shall clean all adjacent areas that may have become contaminated due to the emissions. Documentation regarding the sample numbers, sample locations, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

3. The Contractor shall submit all air monitoring results to DEP within 24 hours of date of air sample collection.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleanup: The Contractor shall maintain all surfaces, including protective coverings (polyethylene sheeting) within each work area, free of accumulations of paint chips/coating debris, dusts, and wastes. Dry sweeping and using compressed air to cleanup a Work area shall be strictly prohibited. HEPA-filtered vacuums and wet methods shall be used to ensure that each Work area remains free of visible paint chips/coating debris, dusts, and wastes.

B. Collection, Separation, and Containerization of Wastes: The Contractor shall collect, separate (by waste stream/waste type), and containerize Lead Wastes (solid and liquid), debris, PPE, and containment materials on a daily basis in accordance with the Lead Management Plan. Where the TCLP analysis for the eight (8) RCRA metals are below hazardous waste standards, all PPE, poly and paint/coating waste

will be characterized as Lead-Containing non-hazardous, contaminated waste, and should not be managed as construction and demolition (C&D) debris.

1. The Contractor shall store all wastes in DOT-approved container systems. No drum/container shall be filled in excess of the capacity marked on the drum/container. All drums/containers shall be sealed and covered immediately after filling, and each drum/container shall have an intact and legible label affixed to it.

2. No water mixed with or contaminated by hazardous waste may be released onto the ground or into any drain or sewer (RCNY Title 15, Chapter 19). It should be noted that a discharge of more than 10 pounds of Lead (this includes 10 pounds of debris containing Lead) onto the ground or into the water within a 24-hour period, shall be considered a violation of the Clean Water Act and shall be treated as a "reportable quantity" in accordance with 40 CFR 117. Such a release shall be grounds for immediate termination of this Contract, and the Contractor shall be liable for any fines, penalties, or remediation costs.

3. The Contractor shall store non-hazardous wastes separately from hazardous wastes, shall provide all non-hazardous waste containers, and shall make all transportation and disposal arrangements for non-hazardous wastes in accordance with federal, state, and local regulations.

C. Storage of Wastes: The Contractor shall ensure that all drummed wastes are stored in a secondary containment system, and that each waste storage area is demarcated with a Physical Boundary. In addition, the Contractor shall post weekly waste inspections and waste inventories in the regulated waste storage area, as well as the following emergency information in accordance with DEP's EHS Policies and Procedures: (a) the name and telephone number of the facility's Emergency Coordinator; (b) the location of fire extinguishers and fire alarms; (c) the location of spill control materials; (d) the telephone number for the fire department (unless the facility has a direct alarm).

D. Labeling: The Contractor shall affix warning labels to all waste drums/containers. At a minimum, all hazardous waste labels shall bear the following information in English:

HAZARDOUS WASTE
FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
HANDLE WITH CARE
[Generator Name, Address, and Telephone Number]
[Specific Contents of Container]
[EPA-Issued Generator Identification Number]
[EPA Waste Identification Number]
[Accumulation Start Date]
[Accumulation End Date]

1. If waste classification is pending analysis, labels shall indicate "Hazardous Waste - Pending Analysis." If wastes contain PCBs, drums/containers must also be labeled per Section 02 84 05 - PCB Management.

E. Sampling and Laboratory Analysis of Paint Removal Wastes: For hazardous waste characterization, the Waste Manager shall sample all potential Lead-Containing Waste Streams in accordance with 40 CFR 261 and 6 NYCRR Part 371. All waste samples shall be collected in the presence of the Engineer using the following procedure:

1. One (1) composite waste sample shall be collected for laboratory analysis from each waste drum that is generated. Each composite sample shall be a mixture of four (4) grab samples. As an example, if the drum is full, collect four grab samples, if the drum is half-full, collect two grab samples, and if the drum is one-tenth full, collect one sample. Grab samples shall be composited into one (1) bulk composite sample. Each composite sample shall undergo Toxicity Characteristic Leaching Procedure (TCLP) analysis for the eight (8) RCRA metals.

2. In addition, if the waste stream is associated with the use of a chemical paint stripping system, the Contractor shall have the laboratory analyze each sample for pH and any other RCRA characteristic that may fail due to the chemical composition of the waste. Furthermore, if the waste stream contains PCB-Containing paint/coating chips, the Contractor shall collect samples in accordance with Section 02 84 05 - PCB Management. The Contractor shall ensure that the laboratory being used is also capable of performing these additional analytical tests.

3. One (1) representative wastewater sample shall be collected for laboratory analysis using appropriate field sampling equipment (e.g., a pipette or bailer), and shall be labeled appropriately.

F. Sampling and Laboratory Analysis of Painted Demolition Debris: The Contractor shall collect representative bulk samples of demolition wastes to determine proper disposal. All bulk samples shall undergo TCLP analysis for the eight (8) RCRA metals. Furthermore, if the waste stream may contain PCB-Containing paint/coating chips, the Contractor shall collect samples in accordance with Section 02 84 05 - PCB Management.

1. Scrap Metal Exemption for Recycling: Under 6 NYCRR 371.1(c)(7), painted scrap metal can be sent to a recycling facility, rather than be discarded as hazardous waste. For DEP to submit a "c7 notification" to the NYSDEC and claim the "scrap metal exemption," the Contractor must first submit notification to their recycling facility indicating that Lead is present on the scrap metal. If PCBs are detected in the paints/coatings on the scrap metal, the Contractor shall also disclose this information to the recycling facility as per Section 02 84 05 - PCB Management. The Contractor shall submit this documentation to the Engineer for approval prior to disposal.

G. Disposal of Wastes: The Contractor shall notify DEP at least 14 business days prior to the removal of any waste drums/containers. All hazardous waste profiles for containerized wastes must be reviewed by the Engineer and signed by DEP as the generator of the waste streams. Wastes shall be disposed of so that drums/containers do not remain on the job site for more than 90 calendar days from the initial "accumulation start date" on the drum/container label. Containers that have reached their storage capacity shall not remain on site, and transportation arrangements shall be made for their immediate removal.

H. Disposal Documentation: Once all waste profiles have been completed, the Contractor shall provide DEP a "Letter of Acceptance" issued from the TSDF indicating that the wastes will be accepted, and a copy of the advance manifest. On the date of disposal, the Contractor shall submit one (1) copy of the completed manifest that has been signed and dated by the initial transporter in accordance with 6 NYCRR 372 and 40 CFR 262, to DEP for signature as Generator. All hazardous waste documentation (e.g., waste profiles, manifests and Land Disposal Restrictions (LDRs)) must be signed by a DEP employee as described in Section 01 35 45- Hazardous Materials Control. Non-hazardous waste documentation may be signed by a DEP-designated alternate.

END OF SECTION

SECTION 02 84 05 – PCB MANAGEMENT
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section details the requirements for construction and demolition activities affecting materials and structures coated with or containing polychlorinated biphenyls (PCBs), as shown on Table No. 4, attached to Section 01 35 45 – Hazardous Materials Control, specified herein, or required to complete the Work, including all affected coatings identified and impacted by the Work.

B. All Work under this Section shall be performed to minimize the creation of airborne emissions (40 CFR 50); minimize the quantity of hazardous waste generated; protect the health and safety of all site personnel and the welfare of the public; and avoid adverse environmental impacts.

C. In the absence of analytical testing results for a specific painted/bitumastic-coated material, the material shall be classified as PCB-containing and lead-containing. If the material is caulking or has a bitumastic coating, the material shall also be classified as asbestos-containing.

D. Small Capacitors and Fluorescent Light Ballasts manufactured prior to 1978 may contain PCBs in their capacitors or potting materials. Unless a Fluorescent Light Ballast is marked "No PCBs" by the manufacturer, it shall be assumed that the ballast contains PCBs. All PCB-containing light ballasts and Small Capacitors shall be removed, handled, packaged, and disposed of in accordance with this Section.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	9
1.06	Quality Assurance	10
1.07	Submittals	13
1.08	Delivery, Storage, and Handling	21
1.09	Spare Parts, Special Tools, and Supplies	21
1.10	Warranty	21
PART 2	PRODUCTS	21
2.01	Manufacturers	21
2.02	Materials / Equipment	21
2.03	Fabrication / Assembling / Finishes	22
2.04	Source Quality Control / Shop Tests	22
PART 3	EXECUTION	22
3.01	Examination / Preparation	22
3.02	Implementation	23

3.03 Field Testing / Quality Control 26
3.04 Startup / Demonstration 27
3.05 Adjusting / Protection / Cleanup 27

1.02 PAYMENT

A. No separate payment will be made for performing any work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s), or allowance(s) as set forth in Section 01 27 00 – Measurements and Payment.

B. Payment for the disposal of PCB Wastes will not be made until a signed copy of the manifest from the Treatment, Storage, and Disposal Facility (TSDF), certifying the amount of PCB Wastes delivered is returned with complete chain-of-custody (COC) documentation to DEP.

1.03 RELATED SECTIONS

A. Section 01 35 27 – Environmental Health and Safety Requirements

B. Section 01 35 45 Hazardous Materials Control

C. Section 01 51 11 – Temporary Water and Sanitary Services

D. Section 01 51 12 – Temporary Heat and Ventilation

E. Section 01 51 30 – Temporary Electrical System

F. Section 01 74 20 – Construction Waste Management

G. Section 02 41 10 – Demolition and Removals

H. Section 02 82 05 – Asbestos Management

I. Section 02 83 05 – Lead Management

1.04 REFERENCES

A. Definitions

1. Abatement: Any measures or set of measures designed to permanently eliminate PCB paint/bitumastic coating hazards. Abatement includes, but is not limited to, the removal of PCB paints/bitumastic coatings or the replacement of PCB-painted/bitumastic-coated surfaces or fixtures. Abatement also includes the removal of paints/bitumastic coatings (with a PCB concentration greater than or equal to 50 parts per million (ppm)) when the underlying substrate is to remain in place. Abatement does not include renovation, remodeling, landscaping, or other activities, when such activities are not designed to permanently eliminate PCB hazards, but instead, are designed to repair, restore, or remodel a given structure or dwelling, even though these activities may incidentally result in a reduction or elimination of PCB hazards. Furthermore, Abatement does not include interim controls (e.g., the spot removal of a PCB paint/bitumastic coating on a surface in order to perform torch cutting at that location), Operations

and Maintenance (O&M) activities, or other measures and activities designed to temporarily reduce PCB hazards.

2. Area Monitoring: Stationary air sampling outside of a PCB Control Area for the purpose of determining compliance with OSHA's Limits for Air Contaminants Table (29 CFR 1910.1000, Table Z-1), and for the purpose of ensuring that airborne PCB concentrations remain below 1.0 mg/m^3 (Aroclor 1242) and 0.5 mg/m^3 (Aroclor 1254) outside of the PCB Control Area during all Work activities that have the potential to disturb PCB-Containing Materials with PCB concentrations greater than or equal to 50 ppm. Area Monitoring for lead will be required if Exposure Monitoring results exceed corresponding Action Levels, Permissible Exposure Limits (PELs), or Threshold Limit Values (TLVs). If asbestos is present, Area Monitoring shall also be conducted in accordance with DEP (RCNY Title 15, Chapter 1) or NYSDOL (12 NYCRR 56) regulations. All Area Monitoring shall follow pertinent NIOSH or ASTM sampling methodologies.

3. Certified Industrial Hygienist (CIH): Refers to an individual employed by the Contractor who is currently certified by the American Board of Industrial Hygiene (ABIH).

4. Competent Person: Defined by OSHA as someone who is capable of identifying existing and predictable hazards in the surroundings or working conditions, and who has authorization to take prompt corrective measures to eliminate them. Duties of the Competent Person include the following: (a) determining prior to the performance of the Work whether PCBs or lead are present in the workplace; (b) establishing PCB Control Areas and assuring that access to and from those areas is limited to authorized personnel; (c) assuring the adequacy of any employee Exposure Monitoring required by OSHA; (d) assuring that all employees exposed to airborne contaminant levels above Action Levels, PEL, or TLV wear appropriate Personal Protective Equipment (PPE), respiratory protection, and are trained in the use of appropriate methods of exposure control for all of the contaminants present; (e) assuring that proper Hygiene Facilities are provided and that workers are trained to use those facilities; (f) assuring that engineering controls specific to the contaminants present are implemented, maintained in proper operating condition, and functioning properly.

5. Decontamination Area: Designated area within the Hygiene Facilities for removing gross contamination from PPE (using a HEPA vacuum), washing away contamination that has accumulated on the skin and hair (using soap and water), removing, and disposing/washing of contaminated PPE, and donning clean clothing that will not potentially contaminate areas outside of a PCB Control Area's Physical Boundary.

6. DOT Hazardous Materials Transportation Training: Training that meets the criteria outlined in 49 CFR 172.704. This training shall include discussions of the following: (a) hazardous materials tables within 49 CFR 172; (b)

material packaging and labeling within 49 CFR 178; (c) shipping papers and placards within 49 CFR 173; (d) material loading and segregation.

7. Exclusion Zone: (See definition of "PCB Control Area").

8. Exposure Monitoring: Personal air sampling performed outside the respirator within the breathing zone of individuals, for the purpose of determining compliance with OSHA's Limits for Air Contaminants Table (29 CFR 1910.1000, Table Z-1). Analytical results obtained from Exposure Monitoring will be used to select appropriate respiratory protection and PPE for individuals within a work area. For the purpose of this Section, Exposure Monitoring samples shall be collected from individuals who are representative of each type work task being conducted by the Contractor, and all Exposure Monitoring shall follow pertinent NIOSH (Method 5503) or ASTM sampling methodologies.

9. Fluorescent Light Ballast: A device that electrically controls fluorescent light fixtures and includes a capacitor containing 0.1 kilograms (kg) or less of dielectric fluid.

10. Hazardous Waste Operations (HAZWOPER) Training: Training that meets the criteria outlined in the OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120). A minimum of 24-hour HAZWOPER training will be required for Work being performed under this Section. However, certain types of Work may require 40-hour HAZWOPER Training. All decisions regarding the specific HAZWOPER Training that will be required for each Work task shall be made by the Engineer.

11. High-Efficiency Particulate Air (HEPA) Filter: A filter designed to remove 99.97% of all particles greater than 0.3 micrometers (μm) in diameter. For the purpose of this Section, HEPA vacuum and local exhaust filtration equipment used by the Contractor shall meet the Standard for Safety High-Efficiency, Particulate, Air Filter Units (UL 586) developed by Underwriters Laboratories.

12. Homogenous Materials: PCB-Containing Materials which are similar in appearance, color, texture, and substrate type.

13. Hygiene Facilities: Facilities within the Physical Boundary of a work area that are set up to prevent cross contamination and are equipped with change areas and separate storage facilities for PPE and clean clothing. Hygiene Facilities shall include adequately supplied hand washing station(s) (i.e., running water, soap, and clean towels) or shower(s) (hot and cold water that is controllable at the tap, soap, shampoo, and clean towels).

14. Organic Vapor Cartridge: A respirator filter typically containing 25 to 40 grams of sorption media such as activated charcoal.

15. OSHA Monitoring: (See definition of "Exposure Monitoring").

16. P-100 Filter: (See definition of: "High-Efficiency Particulate Air (HEPA) Filter").

17. PCB Awareness Training: Training for individuals that have the potential to be exposed to PCB-Containing Materials or PCB Wastes. This training shall include discussions of the following: (a) sources of PCBs; (b) current federal, state, and local regulations pertaining to PCBs (including 40 CFR 761) and other contaminants that may be disturbed during the Work; (c) the health effects of PCBs and other contaminant exposures; (d) state-of-the-art work practices, engineering controls, and procedures for Abatement, removal, construction/demolition, materials handling, housekeeping, and waste management activities that involve PCB-Containing Materials and PCB Wastes; (e) the use and maintenance of PPE and the use and maintenance of respirators in accordance with 29 CFR 1910.134; (f) medical surveillance programs; (g) requirements regarding warning signs, labeling, and Safety Data Sheets (SDSs) in accordance with 29 CFR 1910.1200; (h) responsibilities of the Competent Person.

18. PCB Bulk Product Waste: Waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal is greater than or equal to 50 ppm of PCBs.

19. PCB-Containing Material: Any material that contains, or is coated with, a detectable concentration of PCBs.

20. PCB Control Area: The area within the Physical Boundary where worker Hygiene Facilities are located and where all Work activities take place that involve the disturbance of PCB-Containing Materials and PCB Wastes.

21. PCB Hazardous Waste (per NYSDEC): All solid wastes containing PCB concentrations greater than or equal to 50 ppm. Refer to 6 NYCRR Part 371.4(e) for specific details and exceptions regarding the classification of PCB Wastes as "hazardous wastes" (listed waste B001-B007) in New York State.

22. PCB Waste (TSCA-regulated): Non-specific liquid or solid waste generated during the Abatement, removal, construction/demolition, handling, or cleanup of a PCB-Containing Material with a PCB concentration greater than or equal to 50 parts per million (ppm). PCB Waste also includes any waste (including remediation waste, polyethylene sheeting and PPE) that has been in contact with a material that has a PCB concentration greater than or equal to 50 ppm, regardless of whether the waste itself has a PCB concentration of less than 50 ppm. PCB Wastes are subject to the disposal requirements set forth in Toxic Substances Control Act (TSCA) (40 CFR 761, Subpart D).

23. Perimeter Monitoring: (See definition of "Area Monitoring").

24. Permissible Exposure Limit (PEL): Defined by OSHA as individual exposure, without regard to the use of respirators, to a specific airborne

concentration of a contaminant expressed in milligrams per cubic meter of air (mg/m3) calculated as an 8-hour Time-Weighted Average (TWA). Once a PEL is met or exceeded for a particular contaminant, the Contractor is responsible for meeting specific OSHA requirements, which may include worker Exposure Monitoring, the use of PPE including respiratory protection, the use of Hygiene Facilities, medical surveillance, or training for workers. The following PELs are pertinent to disturbance, removal, construction/demolition, and disposal activities associated with PCB-Containing Materials and PCB Wastes: (a) PCB Aroclor 1254 – 0.5 mg/m3 per 29 CFR 1910.1000, Table Z-1; (b) PCB Aroclor 1242 – 1.0 mg/m3 per 29 CFR 1910.1000, Table Z-1.

25. Personal Monitoring: (See definition of "Exposure Monitoring").

26. Physical Boundary: A physical barrier designated with ropes, "caution tape," or a partition that surrounds a work area in order to limit the entry of unauthorized personnel and delineate "clean areas" from areas that may meet or exceed an Action Level, PEL, or TLV.

27. PCBs: Any group of chlorinated isomers of biphenyl, formerly used in the form of a toxic, colorless, odorless, viscous liquid typically added to lubricants, heat-transfer fluids, and plasticizers.

28. Regulated Area: (See definition of "PCB Control Area").

29. Resource Conservation and Recovery Act (RCRA) Training: Training that meets the criteria outlined in 40 CFR 265.16. This training shall include site-specific discussions of the following: (a) hazardous waste identification; (b) waste storage container use and labeling; (c) waste storage area management; (d) personal health and safety, including fire safety; (e) manifesting and the off-site transportation of wastes; (f) procedures for using, inspecting, repairing, and replacing emergency equipment and monitoring equipment; (g) procedures for communicating with other employees and outside emergency response personnel; (h) responses to fires or explosions; (i) responses to leaks, spills, and potential groundwater contamination incidents; and (j) the shutdown of operations.

30. Small Capacitor: A device for accumulating and holding a charge of electricity and consisting of conducting surfaces separated by a dielectric fluid in a quantity less than 1.36 kg or three pounds. If the weight of the dielectric fluid is unknown, it can be assumed that a Small Capacitor is a capacitor that has a total volume of less than 1,639 cubic centimeters (cm^3) or 100 cubic inches (in^3).

31. TLV: Threshold Limit Value

32. TWA: The average time over a given work period (e.g., an 8-hour workday) of a person's exposure to a chemical or agent. The average is determined by sampling for the chemical or agent throughout the time period.

33. Trigger Activities: Certain activities that involve a disturbance of PCB-Containing Materials or PCB Wastes. Depending upon whether the performance of these activities exceeds an Action Level, PEL or TLV, the requirements may include additional worker Exposure Monitoring, the use of PPE including respiratory protection, the use of Hygiene Facilities, medical surveillance, or training for workers. Examples of Trigger Activities include, but are not limited to, the following: abrasive blasting, welding, torch cutting/burning, heat gun usage, needle gunning/scaling, rivet busting, using a rotopeen, mechanical sanding/grinding, using mechanical shears, hand scraping/sanding, chemical stripping, and the manual demolition of PCB-Containing Materials.

B. Reference Standards

1. The Contractor shall comply with all applicable regulations, standards, and guidelines of federal, state, and local environmental and occupational safety and health agencies regarding PCB-Containing Materials and PCB Wastes. These regulations, standards, and guidelines include, but are not limited to the following:

   a. United States (U.S.) Department of Transportation (DOT):

      1) 49 CFR 171 - General Information, Regulations, and Definitions

      2) 49 CFR 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

      3) 49 CFR 173 – Shippers: General Requirements for Shipments and Packaging’s

      4) 49 CFR 178 – Specifications for Packaging’s

   b. United States Environmental Protection Agency (EPA):

      1) 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards

      2) 40 CFR 116 – Designation of Hazardous Substances

      3) 40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances

      4) 40 CFR 260 – Hazardous Waste Management Systems: General

      5) 40 CFR 261 – Identification and Listing of Hazardous Waste

      6) 40 CFR 262 – Standards Applicable to Generators of Hazardous Waste

7) 40 CFR 263 – Standards Applicable to Transporters of Hazardous Waste

8) 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

9) 40 CFR 265 – Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

10) 40 CFR 268 – Land Disposal Restrictions

11) 40 CFR 302 – Designation, Reportable Quantities, and Notification

12) 40 CFR 761 – Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

13) Method 8082A (SW-846) – Polychlorinated Biphenyls (PCBs) (soxhlet extraction method 3540) by Gas Chromatography

c. National Institute for Occupational Safety and Health (NIOSH):

1) Method 5503 – Polychlorobiphenyls

d. New York City Department of Environmental Protection (DEP):

1) Environmental Health and Safety Policies, Procedures and Guidelines – Vol. II, Spill Prevention, Environmental Release Reporting and Investigation;

2) Environmental Health and Safety Policies, Procedures and Guidelines – Vol. IV, Hazardous Waste Management;

3) Environmental Health and Safety Policies, Procedures and Guidelines – Vol. IV, PCB Management;

4) RCNY Title 15, Chapter 19 – Discharges of Wastewater and Other Materials to Public Sewers

e. New York City Department of Buildings (DOB) – Building Code (Chapter 33)

f. New York State Department of Environmental Conservation (NYSDEC):

1) 6 NYCRR 364 – Waste Transporter Permits

2) 6 NYCRR 370 – Hazardous Waste Management Regulations

3) 6 NYCRR 371 – Identification and Listing of Hazardous Waste

4) 6 NYCRR 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities

5) 6 NYCRR 373 – Hazardous Waste Management Facilities

6) 6 NYCRR 376 – Land Disposal Restrictions

7) 12 NYCRR 56 – Asbestos

g. Occupational Safety and Health Administration (OSHA):

1) 29 CFR 1910 – Occupational Safety and Health Standards

2) 29 CFR 1910.28 – Safety Requirements for Scaffolding

3) 29 CFR 1910.120 – Hazardous Waste Operations and Emergency Response

4) 29 CFR 1910.134 – Respiratory Protection Standard

5) 29 CFR 1910.1200 - Hazard Communication Standard

6) 29 CFR 1926 – Safety and Health Regulations for Construction

7) 29 CFR 1926.62 – Lead in Construction Standard

h. Society for Protective Coatings (SSPC):

1) SSPC Guide 6 - Guide for Containing Debris Generated During Paint Removal Operations

2) SSPC Guide 7 - Guide for the Disposal of Lead-Contaminated Surface Preparation Debris

3) SSPC SP 1, Solvent Cleaning

4) SSPC SP 2, Hand Tool Cleaning

5) SSPC SP 3, Power Tool Cleaning

6) SSPC SP 11, Power Tool Cleaning to Bare Metal

7) SSPC SP 13/ NACE No.6, Surface Preparation of Concrete

8) SSPC SP 15, Commercial Grade Power Tool Cleaning

i. Underwriters Laboratories, Inc. (UL):

1) UL 586 – Standard for Safety High Efficiency, Particulate, Air Filter Units.

1.05 DESCRIPTION

A. Commencement of Work: Five (5) business days prior to the proposed start of the work of this Section at each separate location, the Contractor shall notify the Engineer and the onsite safety staff. No Work may proceed at any location until authorized by the Engineer.

B. The Contractor shall coordinate any required equipment shutdowns with the Engineer prior to starting the Work.

C. Access Restrictions: The Contractor shall inform the Engineer of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed Work) and give them estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall notify other contractors in advance of the disturbance, Abatement, removal, construction/demolition, and disposal Work included herein, to provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.

D. Unexpected Entry into a PCB Control Area: In the event that DEP personnel must enter a PCB Control Area for emergency reasons, the Contractor shall immediately stop Work and cleanup any loose debris, so as to permit the safe entry by DEP personnel. Any disturbance of paints/bitumastic coatings, dusts, materials, or wastes that may potentially generate airborne concentrations of contaminants equal to or above an OSHA Action Level shall not proceed until all DEP personnel have exited from the PCB Control Area.

E. Meetings: In addition to the pre-construction meeting and site walk-through, other meetings may be required or may be requested by the Engineer, including briefings to Site Operations personnel. Written documentation (i.e., "minutes") of all meetings shall be generated by the Contractor, and copies shall be provided to DEP within three (3) business days following each meeting.

1.06 QUALITY ASSURANCE

A. Scheduling: The Contractor shall coordinate and schedule all phases of the Work to be performed under this Section with DEP, subcontractors, material suppliers, and other parties as necessary to ensure the proper execution of the Work.

B. Compliance: In addition to the detailed requirements of this Section, DEP EHS Policies and Procedures, and Section 01 35 27 – Environmental Health and Safety Requirements, the Contractor shall comply with all applicable regulations of federal, state, and local authorities pertaining to the disturbance, Abatement, removal, construction/demolition, handling, storage, transportation, and disposal of PCB-Containing Materials and PCB Wastes. All matters regarding the interpretation of any regulations, standards, or policies shall be submitted to the Engineer for resolution before starting the Work. Where the requirements of this Section, DEP EHS Policies and Procedures, or federal, state, or local regulations conflict or vary, the most stringent requirements or regulations shall apply.

C. Rejection of Non-Complying Items: DEP reserves the right to reject Contractor materials/tools/submittal items that are deemed inappropriate or unacceptable by the Engineer or DEP. Submittal items that may be deemed inappropriate or unacceptable include proposed TSDFs, vendors or subcontractors with previous regulatory citations/violations.

D. Suspect Material Characterization: To classify caulking or a paint or bitumastic coating as non-PCB containing, a paint chip/coating sample must be collected as a grab sample from the source. The sample shall be sent to an analytical laboratory meeting the requirements of this Section.

1. Suspect PCB-Containing Paints/Coatings: Although there are no certification requirements pertaining to an individual that collects paint chip samples in an industrial or commercial setting, this Section requires paint chip sampling to be performed by an individual who has successfully completed a PCB Awareness Training course (within the past year) as defined in this Section.

2. Suspect ACM: All caulking and bitumastic coatings are considered suspect ACM. Therefore, if a sample will be collected, the sampling shall be performed by a certified DEP Asbestos Investigator or NYSDOL Asbestos Inspector.

3. Estimate an approximate number of samples to adequately characterize painted/coated surfaces. Collect grab samples that include all layers of paint/coating from different areas randomly dispersed throughout the painted surface area. Grab samples are not to be composited.

4. PCB concentrations are based on the cumulative total of the nine (9) Aroclor cogeners (aka PCB compounds) analyzed by EPA Method SW 846-8082A (soxhlet extraction method 3540) by Gas Chromatography.

E. Qualifications:

1. The Contractor or their proposed PCB removal subcontractor shall have successfully completed at least two (2) projects of comparable scope and methodologies and shall document the following: (a) the name, address, and phone number of each facility where the work was performed; (b) the volume and type of each material that was abated/removed; (c) the specific methods of Abatement/removal used (including the tools, technologies, and engineering controls employed).

2. Competent Person:

a. When disturbing materials and wastes with PCB concentrations greater than or equal to 50 ppm, the Contractor shall have on staff and assigned to this Contract a Competent Person who has successfully completed:

1) 40-hr HAZWOPER Training;

2) PCB Awareness Training (annual), and RCRA Training courses as defined in this Section.

a) Each training course shall be current in accordance with the course and regulatory requirements.

b. The Competent Person shall have a minimum of two (2) years' experience with work involving PCBs, and shall have served as the

Competent Person on at least three (3) projects of comparable scope and methodologies to the work being performed under this Section.

c. The Competent Person shall be on site during all PCB-related work activities. It should be noted that depending upon the specific contaminants present during the work, additional training for the Competent Person may be required.

3. PCB Waste Manager:

a. When disturbing materials and wastes with PCB concentrations greater than or equal to 50 ppm, the Contractor shall have on staff and assigned to this Contract a PCB Waste Manager who has successfully completed:

1) DOT Hazardous Materials Transportation Training;

2) RCRA Training course, completed within the past year in the form of either an initial course or a refresher course;

3) 24-hr HAZWOPER Training;

4) PCB Awareness Training (annual) as defined in this Section.

b. The PCB Waste Manager shall have a minimum of two (2) years experience on projects involving PCB Wastes. It is acceptable for an individual who meets the criteria of the Competent Person, to also serve as the PCB Waste Manager for this Contract as long as the individual fulfills all of the requirements of this paragraph.

4. PCB Worker:

a. When disturbing materials and wastes with PCB concentrations greater than or equal to 50 ppm, the Contractor shall have on staff and assigned to this Contract a sufficient number of PCB Workers who have successfully completed:

1) PCB Awareness Training course (annual) as defined in this Section.

b. Each PCB worker shall have a minimum of one (1) year of experience on projects involving PCBs and shall have worked on at least three (3) projects of comparable scope and methodologies to the work being performed under this Section.

5. Worker (low PCB concentrations):

a. When disturbing materials and wastes with PCB concentrations less than 50 ppm, the Contractor shall have on staff and assigned to this Contract a sufficient number of workers who have successfully completed:

1) PCB Awareness Training course (annual) as defined in this Section.

b. Until a negative exposure assessment has been established via Exposure Monitoring, workers must wear appropriate respiratory protection.

6. Air Monitor:

a. When disturbing any detectable concentration of PCBs, the Contractor shall have an Air Monitor assigned to this Contract who has successfully completed:

1) PCB Awareness Training course (annual) as defined in this Section.

b. The Air Monitor shall have a minimum of two (2) years experience in conducting Area Monitoring and Exposure Monitoring on projects involving PCBs.

c. It is acceptable for an individual who meets the qualification requirements for Competent Person or PCB Waste Manager to also serve as the Air Monitor for this Contract, as long as the individual satisfies all of the requirements of this paragraph.

1.07 SUBMITTALS

A. Thirty (30) business days prior to the Work of this Section or as directed by the Engineer, the Contractor shall submit the following to the Engineer:

1. PCB Inspection and Sampling Plan: The Contractor shall provide a PCB Inspection and Sampling Plan to identify suspect PCBs, not otherwise sampled during Design, and collect samples, as appropriate during the inspection. This plan shall include at a minimum:

a. At a minimum, the inspection shall be performed by an Environmental Professional, as defined in this Contract, who shall have PCB awareness training (annual), and OSHA 10-hr certification, and shall have performed similar inspection work on at least three (3) projects of similar scope.

b. Credentials of the laboratory providing sample analysis, including current certification by the New York State Department of Health's Environmental Laboratory Approval Program (ELAP) and by the American Industrial Hygiene Association (AIHA).

c. Sample collection, analysis, and reporting protocol.

d. Health and safety protocol (Job Hazard Analysis) for all investigation activities.

2. PCB Inspection Report: The Contractor shall provide a PCB Inspection Report prepared by the Environmental Professional summarizing the results of all inspection activities, and as applicable, a sampling narrative,

laboratory data packages, and inventory of all identified suspect and confirmed PCB-Containing Materials.

3. PCB Safe Work Practices: Each Contractor that will disturb PCB-Containing Materials with a PCB concentration less than 50 ppm during the course of Work to be performed under this Section shall submit detailed, project-specific PCB Safe Work Practices designed to protect their workers and control the spread of potential PCB contamination. Work requiring the development of PCB Safe Work Practices includes, but is not limited to, the mechanical disturbance of paints/coatings (e.g., drilling or sawing, or spot removal). The PCB Safe Work Practices shall be signed and dated by a CIH meeting the definition in this Section, and shall include the following elements:

   a. Section on the procedures and methodologies that will be used to conduct Exposure Monitoring. Also, provide the name and qualifications (i.e., training and experience documentation) of the Air Monitor who shall, at a minimum, satisfy the qualification requirements set forth in this Section;

   b. Section on housekeeping procedures to be used for maintaining clean work areas and clean Hygiene Facilities;

   c. Task Analysis: Each task analysis shall include, but is not limited to, the following information: (a) the type of Work activity; (b) the tools/equipment that will be used and their respective decontamination procedures; (c) operation and maintenance practices and procedures that will be used for the tools/equipment (SSPC SP 1, 2, 3, 11, 13 and 15 as applicable); (d) the types of PCB-Containing Materials that may be disturbed when performing the activity; (e) the engineering controls that will be used to control the spread of contamination during the activity; (f) housekeeping procedures that will be used during the activity; (g) PPE and proposed respiratory protection that will be used for the activity;

   d. Equipment and Supplies: Identify the equipment and supplies that will be used to perform the Work;

   e. Rental Equipment Notification: If rental equipment is to be used during the Work, the Contractor shall notify the rental agency in writing concerning the intended use of the equipment;

   f. SDSs: Provide SDSs for all chemical products to be used for the Work;

   g. Medical Clearance for Respiratory Protection: For all activities that disturb PCB-Containing Materials with a PCB concentration less than 50 ppm, the Contractor shall provide a sufficient number of properly trained and experienced workers, each of whom shall: (a) have received a medical exam that included a Pulmonary Function Test (PFT) within the past year; (b) have received written medical

clearance within the past year, by a licensed physician, to wear a respirator; (c) have received a qualitative or quantitative respirator fit-test for the specific respirator the employee will be using for this Work within the past year;

h. Employee Documentation: For all activities that may disturb PCB-Containing Materials with a PCB concentration less than 50 ppm, the Contractor shall provide a sufficient number of properly trained and experienced workers, each of whom shall: (a) have written proof of training (e.g., certificates) in accordance with the qualification requirements of this Section for workers and Air Monitors that will be used for the Work; (b) dates and written proof of respiratory clearance and a medical exam in accordance with this Article; (c) dates and written proof of a respirator fit-test in accordance with this Article.

4. PCB Management Plan: Each Contractor that will disturb PCB-Containing Materials with a concentration of PCBs greater than or equal to 50 ppm, and PCB Wastes during the course of Work to be performed under this Section shall submit a detailed, project-specific PCB Management Plan that addresses work procedures and equipment to be used during the disturbance, removal, handling, collection, and disposal of PCB-Containing Materials and PCB Wastes. Work requiring a PCB Management Plan includes, but is not limited to, Abatement, spot removal and construction/demolition activities. The PCB Management Plan shall be prepared in accordance with OSHA Construction Standards and all other pertinent federal, state, and local regulations, including DEP (RCNY Title 15, Chapter 1) or New York State Department of Labor (NYSDOL) (12 NYCRR 56) asbestos regulations, only if asbestos is present. In addition, the PCB Management Plan shall follow all DEP EHS Policies and Procedures (referenced in this Section) and shall be coordinated with the Engineer. The PCB Management Plan shall also be signed and dated by a CIH meeting the definition in this Section.

   a. If the PCB-Containing Materials or PCB Wastes that will be disturbed also contain asbestos or lead, it is acceptable to integrate the PCB Management Plan elements into the relevant Asbestos Work Plan (required under Section 02 82 05 - Asbestos Management) or Lead Management Plan (required under Section 02 83 05 - Lead Management and SSPC Guide 7). PCB Management Plan elements that are integrated into an Asbestos Work Plan or Lead Management Plan must still satisfy all of the requirements of this Section. The PCB Management Plan (or relevant Asbestos Work Plan or Lead Management Plan) shall include the following elements:

      1) PCB Control:

a) Drawings showing the location and details of the following: (a) each PCB Control Area; (b) each Hygiene Facility; (c) proposed electrical hookups; (d) proposed water hookups: (e) each waste storage area: (f) restroom areas; (g) areas designated for eating, drinking, and smoking;

b) Section on the interfacing of trades (i.e., other contractors) and the sequencing of PCB-Related Work;

c) Section on the collection, handling procedures, and disposal of PCB-Containing Materials with a PCB concentration equal to or greater than 50 ppm, and PCB Wastes (including the collection, filtering, and disposal of wastewater). If reusable equipment used during the Work will be in contact with PCB-Containing Materials or PCB Wastes, the Contractor shall submit an equipment decontamination procedure using a Performance-based Decontamination Fluid (PODF) in accordance with 40 CFR 761;

d) Section on the procedures and methodologies that will be used to conduct Exposure Monitoring and Area Monitoring. Also, provide the name and qualifications (i.e., training and experience documentation) of the Air Monitor who will be responsible for conducting the Air Monitoring activities. The Air Monitor shall at a minimum, satisfy the qualification requirements set forth in this Section;

e) Section on housekeeping procedures to be used for maintaining clean work areas and clean Hygiene Facilities;

f) Section on the specific methods and procedures of emissions control that will be used to ensure that airborne contaminant levels do not meet or exceed an OSHA PEL outside of each PCB Control Area;

g) Task Analysis: Each task analysis shall include, but is not limited to, the following information: (a) the type of Work activity; (b) the tools/equipment that will be used; (c) operation and maintenance practices and procedures that will be used for the tools/equipment; (d) the types of PCB-Containing Materials that may be disturbed or PCB Wastes that

may be generated when performing the activity; (e) the engineering controls that will be used to control the spread of contamination during the activity; (f) the proposed crew size for the activity and individual employee responsibilities during the activity; (g) housekeeping procedures that will be used during the activity; (h) PPE and proposed respiratory protection that will be used for the activity;

h) Equipment and Supplies: Identify the equipment and supplies that will be used to perform the Work;

i) Rental Equipment Notification: If rental equipment is to be used during the Work, the Contractor shall notify the rental agency in writing concerning the intended use of the equipment.;

j) SDSs: Provide SDSs for all chemical products (including chemical stripping products and PODFs) to be used for the Work;

k) The name and qualifications (i.e., experience and training documentation) of the Competent Person who shall satisfy the qualification requirements set forth in this Section.

2) Waste Management:

a) The identification of PCB-Containing Materials with a PCB concentrations equal to or greater than 50 ppm, and PCB Wastes associated with the Work;

b) The estimated quantity of each waste stream (regulated and non-regulated) that will be generated and disposed of;

c) The name, address, 24-hour phone number, and current permit documentation for each TSDF indicating that the facility is approved by federal, state, and local regulatory agencies to receive PCB-Containing Materials with a PCB concentration equal to or greater than 50 ppm, and PCB Wastes. The documentation shall include an “acceptance letter” from each TSDF indicating its ability to accept the specific waste streams that will be generated during Work performed under this Section;

d) Current 6 NYCRR 364 permit documentation for the waste transporter that will transport PCB-

Containing Materials with a PCB concentration equal to or greater than 50 ppm, and PCB Wastes from the work site to the TSDF.;

e) Spill prevention, containment, and cleanup contingency measures to be followed during a suspected PCB emissions/bulk material release or emergency situation.;

f) Section on the on-site handling, storage, removal, and disposal of waste materials, including but not limited to the following: (a) secondary containment system for each drum storage area; (b) description of the waste storage areas; (c) the methods and procedures that will be used to collect and containerize wastes on a daily basis; (d) types of containers; (e) the submittal of weekly regulated waste inspection and inventory records;

g) The name and qualifications (i.e., experience and training documentation) of the PCB Waste Manager.

b. A detailed schedule for the implementation of the PCB Management Plan elements, including starting and completion dates for the Work, and shall allow adequate time for cleanup, inspections, and Air Monitoring activities.

c. Medical Surveillance: For all activities that disturb PCB Containing Materials with PCB concentrations that are greater than or equal to 50 ppm, and PCB Wastes, the Contractor shall provide a sufficient number of properly trained and experienced workers, each of whom shall: (a) have completed initial blood testing for PCBs; (b) have received a medical exam that included a PFT within the past year; (c) have received written medical clearance within the past year, by a licensed physician, to wear a respirator; (d) have received a qualitative or quantitative respirator fit-test within the past year for the specific respirator the employee will be using for this Work.

d. Employee Documentation: For all activities that take place within a PCB Control Area, each worker shall: (a) have resumes and training (e.g., certificates) for PCB workers, Competent Persons, PCB Waste Managers, and Air Monitors; (b) initial medical surveillance, dated within the past year, and proof of participation in the employer's ongoing medical surveillance program; (d) dates and written proof of respiratory clearance and a medical exam; (e) dates and written proof of a respirator fit-test.

e. A current (i.e., within the last month) signed and notarized statement disclosing all OSHA, EPA, and DOT citations/violations within the past three (3) years for the company performing the PCB Abatement.

5. Analytical Laboratory Qualifications for Analyzing Suspect PCB-Containing Materials and Wastes: Submit the name, address, and telephone number of each analytical laboratory selected to perform the analyses of waste samples (solid and liquid), air samples collected for Area Monitoring and Exposure Monitoring purposes, and paint/bitumastic coating samples collected to classify painted/coated surfaces, including. copies of current AIHA and ELAP certificates.

B. Field Reports and Recordkeeping: During all Work performed under this Section, the Contractor shall maintain and provide the following documentation:

1. Air Monitoring Documentation: All PCB Air Monitoring results and daily Air Monitoring reports shall be provided to DEP within 24-hours from the date the samples are collected, including signed, complete COC documentation.

a. Each signed daily Air Monitoring report shall include, but not be limited to, the following information: (a) sample "start" and "stop" times; (b) flow rates (initial and final) for each sample; (c) the total volume of air collected for each sample; (d) sample location descriptions/sample location drawings/names of individuals being sampled; (e) types (i.e., makes and models) of sampling equipment used; (f) types of sample media (i.e., filters and cassettes) used; (g) the most recent calibration dates, along with the calibration results, for the sampling equipment used; (h) the name of the Air Monitor that conducted the Air Monitoring; (i) dates that the Air Monitoring was conducted; (j) work tasks being performed during the Air Monitoring; (k) unique sample numbers used to identify each sample; and, (l) highlighting of all PEL exceedances.

2. Waste Documentation: Completed and signed waste manifests from TSDFs shall be provided to DEP no later than thirty (30) calendar days of disposal. In addition, on-site waste storage areas shall be inspected weekly by the PCB Waste Manager.

a. Each waste storage area inspection shall be coordinated with the Engineer, signed by the inspector, and shall be provided to DEP within 24-hours of the inspection date. The report shall include: (a) the name of the inspector; (b) descriptions of waste streams; (c) types, quantities, and physical condition of waste containers;(d) proper labeling for each waste containers; (e) secondary containment systems being used; (f) storage area security method to prevent any unauthorized entry.

b. In addition to performing weekly waste storage area inspections, the PCB Waste Manager shall also maintain an ongoing waste inventory, including: (a) specific dates that each waste container was added/removed from the waste storage area; (b) the full name (printed) and signature of the individual responsible for adding/removing each waste container from the waste storage area.

3. PCB Control Area Inspection Documentation: PCB Control Areas shall be inspected daily by the Competent Person.

   a. All signed reports shall be provided to DEP within 24-hours after the inspection is completed. The content of these reports shall include: (a) the types of work being performed; (b) the names of the PCB workers, Competent Person, PCB Waste Manager, and Monitor on site, including company names; (c) the types of Air Monitoring, including the number of samples being collected; (d) any non-compliance issues observed, including the corrective actions that were taken to achieve compliance.

4. Contractor Project Record: The Contractor's Competent Person shall maintain a project record at the Work Site that shall be made available to the Engineer or DEP for review at any time and shall be submitted to DEP within 24-hours after the completion of the Work.

   a. At a minimum, the Contractor Project Record shall contain the following information: (a) copies of training certificates for all individuals involved with the Work; (b) copies of all Air Monitoring results generated during the Work; (c) copies of all available caulking and paint chip/bitumastic coating sample analytical data and survey reports related to the Work; (d) copies of all daily sign-in sheets; (e) copies of all SDSs pertaining to all chemicals being used during the Work; (f) a copy of the Contractor's PCB Management Plan; (g) copies of all daily PCB Control Area inspection records; (h) copies of all weekly waste storage area inspection records; (i) a copy of the waste inventory; (j) a copy of the Contractor's Hazard Communication (HAZCOM) program.

5. Daily Sign-In Sheets: The Contractor shall generate daily sign-in sheets for all individuals entering and exiting each PCB Control Area. The daily sign-in sheets shall be maintained by the Competent Person and shall be made available to the Engineer or DEP for review at any time during the Work. All daily sign-in sheets shall be submitted to DEP within 24-hours after the completion of the Work.

   a. At a minimum, each daily sign-in sheet shall include: (a) the individual's printed name and signature; (b) company name; (c) the time of entry and exit from each PCB Control Area.

6. HAZCOM Program: The Contractor's HAZCOM program shall be made available to the Engineer or DEP for review at any time during the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Respirators: The Contractor shall select respirators approved by the NIOSH for use in areas where paints/bitumastic coatings, dusts, materials, or wastes containing contaminants may be disturbed. At a minimum, the Contractor shall provide each individual with a half-face, negative pressure, air purifying respirator equipped with HEPA/P-100 Filter cartridges and Organic Vapor Cartridges, until Exposure Monitoring results indicate that respiratory protection can be modified. The Contractor's CIH shall make all determinations regarding respiratory protection modifications that will be implemented for the Work. All modifications shall be in accordance with OSHA requirements, the Contractor's PCB Management Plan, and any relevant Asbestos Work Plan or Lead Management Plan associated with the Work.

B. PPE: The Contractor shall provide personnel who have a potential to be exposed to materials or wastes containing contaminants, with appropriate PPE as prescribed by the Contractor's CIH.

C. HEPA Filters: HEPA/P-100 Filters used in vacuuming equipment, power tools, and local exhaust equipment must meet or exceed any manufacturer's specifications and recommendations, as well as specifications presented in the Standard for Safety High Efficiency, Particulate, Air Filter Units (UL 586).

D. Waste Containers: Containers for the storage of all PCB Wastes shall be DOT-approved and shall be provided by the Contractor.

E. Abrasives: Mechanical paint/bitumastic coating removal equipment shall not use any products containing crystalline silica, and the equipment shall not utilize any non-recoverable materials or any cutting materials which introduce toxic or hazardous materials into the environment.

F. Chemical Strippers: The Contractor shall utilize an environmentally safe chemical paint stripping system, with demonstrated suitability and efficiency in preparing cast-in-place concrete, cement, and plaster surfaces that are free of any visible residues of paints/bitumastic coatings. The system shall include non-alkaline or alkaline strippers that provide the lowest possible level of toxicity consistent with the types of paints/bitumastic coatings to be removed. Neutralization products and procedures shall be provided for all alkaline stripping systems, no stripping system shall contain methylene chloride, and the stripping system shall be low in volatile organic compounds (VOCs).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Hygiene Facilities: The Contractor shall provide functional Hygiene Facilities as defined in this Section that are appropriate for the types of Work to be performed under this Section. The Contractor shall ensure that employees do not leave a PCB Control Area wearing any potentially contaminated PPE. Using compressed air to dislodge dust from clothing/PPE shall be strictly prohibited. The Contractor shall collect, test, and properly dispose of all wastewater generated from Hygiene Facilities.

1. Handwash Stations: The Contractor shall provide functioning handwash stations on all projects that disturb PCB-Containing Materials with a PCB concentration equal to or greater than 50 ppm, or PCB Wastes. Handwash stations shall have running water at the tap, clean towels, and soap per 29 CFR 1926.51. Substituting “hand wipes” in place of soap and running water will not be acceptable.

2. Showers: The Contractor shall provide shower facilities for use by employees whose airborne exposure to PCBs is above an OSHA PEL. When shower facilities are necessary, employees are required to shower at the end of the work shift each day prior to leaving the PCB Control Area that they are working in.

B. Utilities: The temporary use of any on-site utilities shall be subject to the approval of DEP. The Contractor shall furnish all water, hoses and water filtration devices needed for the Work as per 01 51 11 Temporary Water and Sanitary Services; as well as any temporary electrical hookups and temporary lighting to the PCB Control Area as per 01 51 30 Temporary Electrical System. All temporary lighting and temporary electrical service to a PCB Control Area shall be provided by the Contractor and shall be in weather-proof enclosures and be ground fault protected.

Also, the Contractor shall supply all heating and ventilation equipment needed for the Work as per 01 51 12 Temporary Heat and Ventilation.

C. Signs: The Contractor shall post conspicuous warning signs at all approaches to work areas and waste storage areas. Signs shall comply with federal, state, and local regulations, including the requirements of OSHA. Signs shall not be removed until all Abatement, removal, and construction/demolition activities have been completed. At a minimum, each sign shall bear the following information in English and the predominant language that is spoken by the Contractor's employees if English is not spoken:

WARNING
PCB WORK AREA
POISON
NO SMOKING, EATING OR DRINKING

1. Each sign shall be appropriately modified to include additional warnings for other contaminants that are identified during Exposure Monitoring.

D. Physical Boundary Delineation: The Contractor shall clearly delineate each work area and waste storage area with a Physical Boundary as defined in this Section.

E. Work Area Preparation: The Contractor shall utilize HEPA-filtered vacuums, and wet methods during the initial cleaning of each work area. Prior to removal from each work area, all movable objects and mounted objects that can be removed shall be pre-cleaned using HEPA-vacuums and wet methods. Fixed objects that must remain within each work area shall be pre-cleaned using HEPA vacuums and wet methods, and subsequently covered with 6-mil polyethylene sheeting.

3.02 IMPLEMENTATION

A. Bulk Removal

1. Protection of Existing Work to Remain: All Work involving the disturbance of PCB-Containing Materials and PCB Wastes must be conducted without damage to, or contamination of equipment or surfaces within the work areas or other areas adjacent to the work areas. All such damage or contamination shall be immediately corrected and cleaned up by the Contractor at the Contractor's expense.

2. Prohibited Activities: Contractors shall not conduct activities that are prohibited by OSHA and EPA regulations. The following activities are prohibited, regardless of whether they are conducted subject to an exposure assessment and written compliance program: (a) burning-off paints/bitumastic coatings; (b) using heat guns operating above 1100° F; (c) dry machine sanding, grinding, or blasting paint without a HEPA vacuum exhaust tool; (d) uncontained hydroblasting or high-pressure washing; (e) welding painted/coated surfaces unless the paint/coating is removed at least 4-inches from area of heat application (per 29 CFR 1926.345(c)(1)), and local exhaust ventilation is used.

3. Test Patches: Prior to choosing the paint removal method(s) for paints/bitumastic coatings, the Contractor shall perform test patches on surfaces subject to Abatement or spot removal, to determine if the method(s) meet the requirements of this Section.

4. Mechanical Removal Equipment: The use of mechanical equipment to remove asbestos-containing caulking or bitumastic coatings will require compliance with DEP (RCNY Title 15, Chapter 1) or NYSDOL (12 NYCRR 56) asbestos regulations, including the use of a full containment enclosure under negative air pressure.

    a. When removing paints/bitumastic coatings from metal surfaces, the paints/bitumastic coatings must be removed to the extent that only the bare metal remains (i.e., no mill scale remains). In the case of substrates other than metal (e.g., concrete, brick, and block), paints/bitumastic coatings shall be removed from the surface of the substrate to the extent that flaking and peeling will not occur subsequent to the performance of the Work. Acceptance of the Work shall be contingent upon inspection of the substrate surfaces by the Engineer and must demonstrate the absence of residual paint/coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and tools meeting the performance specifications outlined below:

        1) The Contractor shall utilize a vacuum-assisted power tool system with demonstrated suitability and efficiency in preparing metal surfaces to the SSPC SP-11 standard, and with demonstrated effectiveness in maintaining PCB emissions below OSHA exposure limits during the disturbance of paints/bitumastic coatings. Such systems may include dustless needle guns, dustless roto peens, and dustless right-angle grinders, all of which capture dust and debris at the cutting tool edge, and transport the material under vacuum conditions to an air-tight disposal container. Dustless needle guns shall only be utilized on metal surfaces.

        2) The vacuum-assisted power tool system shall also be designed to permit the removal and replacement of collection containers under negative pressure in order to prevent the release of dusts. The system shall be equipped with an automatic “shut-off” in the event of vacuum failure.

        3) Abrasive/recovery tools shall be monitored at all times by a device capable of determining recovery at the face of each tool, and capable of automatically disabling the tool in the event that recovery levels are insufficient. The monitor, at a minimum, shall have the following features: (a) a remote

warning light; (b) an adjustable recovery set point; (c) automatic equipment disabling capabilities; (d) a sensing range of 0 5 pounds per square inch (psi); (e) solid state photohelic instrumentation; (f) remote sensing at the face of the tool.

4) The safe recovery point shall be calibrated each day before start-up, or each time a new tool or vacuum source is used. All manufacturer recommendations shall be followed with respect to the set up and use of the monitor, and the manufacturer's operations manual shall be kept on site at all times. A daily log shall be maintained by the Contractor, identifying all calibrations of recovery levels, as well as any "down time" as a result of insufficient recovery levels.

5) The cutting head of the vacuum-assisted power tool system that is used on flat surfaces shall be capable of cutting to within 1-1/2" of any inside corner, molding, or edge, and may include dustless roto peens or dustless needle guns. Tools for corners and moldings shall be specifically designed for that purpose, and conform to all inside corners, outside corners, curved, flat, and angled surfaces that are to be abated under this Section. These tools shall also maintain vacuum control at the Work surface/cutting head interface at all times. HEPA vacuum-shrouded needle guns may be used for non-flat surfaces in accordance with manufacturer recommendations. Vacuum-assisted finishing tools, such as right-angle grinders, may be used to achieve the SSPC SP 11 standard, but may not be used for primary removal.

6) Vacuum-assisted power tool systems meeting all of the specifications outlined herein, may be used pending the submittal of all required performance documentation, and their acceptance by the Engineer. Any tools which do not meet all of the specifications outlined herein, shall be removed from the project site immediately, and shall not be used for the Work to be performed under this Section.

5. Chemical Strippers: Acceptance of the Work shall be contingent upon inspection of the abated substrate surfaces by the Engineer and must demonstrate the absence of residual paint/bitumastic coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and paint stripping systems meeting the performance sections outlined below:

a. The Contractor shall utilize a chemical paint stripping system with a demonstrated effectiveness in maintaining PCB emissions below OSHA exposure limits during the disturbance of paints/bitumastic

coatings. The Contractor shall utilize a mechanical ventilation system during the Work that exhausts away from occupied areas. The application of all paint stripping systems shall be in accordance with manufacturer recommendations.

b. The Contractor should note that more than one (1) product may be required to strip PCB-containing paints/bitumastic coatings. The use of multiple products shall be in accordance with work practices approved by the individual manufacturer of each chemical paint stripping compound.

c. All chemical paint stripping products shall be presented to the Engineer for approval prior to the start of any Work to be performed under this Section. The manufacturer's labels on each container shall be intact and legible.

d. Chemical paint stripping systems may be used pending the submittal of all required performance documentation, and its acceptance by the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Air Monitoring

1. Exposure Monitoring: For Work involving the disturbance of any detectable concentration of PCBs, the Contractor shall collect personal air samples from employees who are anticipated to have the greatest risk of exposure, as determined by the Contractor's CIH or Competent Person. Personal air samples shall be collected during every work shift from at least one (1) employee that is representative of each type of work task that is being performed. Each personal air sample shall "run" for the employee's entire work shift in order to ensure that enough volume (of air) is collected, and an accurate 8-hour TWA can be calculated. Documentation regarding the sample numbers, specific shift when the sampling was conducted, the work tasks that were sampled, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

a. If PCB concentrations being disturbed are less than 50 ppm, Exposure Monitoring may be discontinued following a complete negative exposure assessment and approval from the Engineer and the Contractor's CIH. A negative exposure assessment is defined as current initial exposure monitoring using breathing zone air samples representing the 8-hour TWA exposure for each individual who are representative of each task being conducted. Following discontinuation of exposure monitoring, if there is a change to work practices, exposure monitoring shall again be performed until a second negative exposure assessment is conducted and analyzed.

2. Area Monitoring: If PCB concentrations being disturbed are greater than or equal to 50 ppm, the Contractor shall collect a minimum of two (2) area air

samples outside of each PCB Control Area on a daily basis for the duration of the Abatement, removal, or construction/demolition Work, as well as any other Work involving the disturbance of PCB-Containing Materials or PCB Wastes. During sampling activities, all air sample filter cassettes shall be positioned approximately five to six feet above the ground (to simulate an individual's breathing zone) and shall not be placed immediately adjacent to obstructions (e.g., walls or columns) which may restrict the flow of air to the filter cassettes. Each air sample shall be analyzed for all contaminants identified during the exposure assessment. If area Air Monitoring indicates an emission level in excess of an OSHA PEL outside of a PCB Control Area, all Work in that area shall be stopped immediately. The Contractor shall then take immediate corrective actions to reduce emission levels to below the OSHA PEL(s), and the Contractor shall clean all adjacent areas that may have become contaminated due to the emissions. Documentation regarding the sample numbers, sample locations, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

3. The Contractor shall submit all Air Monitoring results to DEP within 24 hours after the air sample was collected.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleanup: The Contractor shall maintain all surfaces, including protective coverings (polyethylene sheeting) within each work area, free of accumulations of paint chips/coating debris, dusts, and wastes. Dry sweeping and using compressed air to cleanup a work area shall be strictly prohibited. HEPA-filtered vacuums and wet methods shall be used to ensure that each work area remains free of visible paint chips/coating debris, dusts, and wastes. Perform work in accordance with SSPC Guide 6.

1. Equipment Decontamination: All reusable equipment (e.g., hand tools and power tools) that has been in contact with materials that have a PCB concentration greater than or equal to 50 ppm and PCB Wastes, shall be thoroughly decontaminated prior to being removed from the PCB Control Area in accordance with 40 CFR 761.79(c)(2)(i), which permits "swabbing surfaces that have contacted PCBs with a solvent." The solvent shall be a PODF as defined in 40 CFR 761.79(c)(3)(iv)(C) or (D). Used decontamination materials (e.g., rags used to swab equipment) shall be collected, stored, and disposed of in accordance with this Article.

B. Collection, Separation, and Containerization of Wastes: The Contractor shall collect, separate (by waste stream/waste type), and containerize PCB containing wastes (solid and liquid), debris, PPE, and containment materials on a daily basis in accordance with the PCB Safe Work Practices or PCB Management Plan.

1. If any source sample from a specific work area indicates that PCBs in paints/coatings are greater than or equal to 50 ppm, then all waste from that area will be characterized as TSCA-regulated waste. All waste streams must be segregated into separate drums and labeled with PCB waste labels, including out of service date (when PCB waste is first place in the drum) in addition to RCRA hazardous waste labels (pending analysis). This may include one or more drums for paint chips, chemical stripper waste, and HEPA filters associated with HEPA vacuums. Other waste such as PPE, rags and polyethylene sheeting from a specific work area may be comingled in drums separate from the drums containing paint chips, stripper waste and HEPA filters.
2. If all source samples from a specific work area indicate that PCBs in paints/coatings are less than 50 ppm, then all PPE, poly and paint/coating waste from that area will be characterized as PCB-containing non-hazardous or hazardous waste pending TCLP analysis of the eight (8) RCRA metals in the waste stream and should not be managed as C&D debris. Drums should be labeled with RCRA hazardous waste labels (pending analysis). All waste streams shall be segregated into separate drums. Paint chips and HEPA filters shall be drummed as one waste stream from each work area, and polyethylene sheeting, rags, paper towels and PPE from each work area will be drummed as a separate waste stream.
3. The Contractor shall store all wastes in DOT-approved container systems. All drums/containers shall be labeled, sealed and covered immediately after filling.
4. No water mixed with or contaminated by hazardous waste may be released onto the ground or into any drain or sewer. It should be noted that a discharge of more than 1 lb. of PCBs onto the ground or into the water within a 24-hour period, shall be considered a violation of the Clean Water Act and shall be treated as a "reportable quantity" in accordance with 40 CFR 116, 40 CFR 117, and 40 CFR 302. Such a release shall be grounds for immediate termination of this Contract, and the Contractor shall be liable for any fines, penalties, or remediation costs.
5. The Contractor shall store non-hazardous wastes separately from hazardous wastes and TSCA-regulated wastes, shall provide all non-hazardous waste containers, and shall make all transportation and disposal arrangements for non-hazardous wastes in accordance with federal, state, and local regulations. TSCA-regulated PCB waste must be disposed within 180 days subject to the requirements of 40 CFR 761.65, in addition to any RCRA hazardous waste storage requirements (i.e., 90 days), as applicable.

C. Storage of Wastes: The Contractor shall ensure that all drummed wastes have secondary containment, and that each waste storage area has a Physical Boundary. In addition, the Contractor shall post weekly waste inspections and waste inventories in the regulated waste storage area, including the following emergency information: (a) contact details for the facility's Emergency Coordinator; (b) map

indicating the location of fire extinguishers and spill control materials; (d) the telephone number for the fire department (unless the facility has a direct alarm).

D. Labeling: The Contractor shall affix warning labels to all waste drums/containers. Labels must be filled out completely at the point of generation when waste is first containerized. PCB labels shall be used to designate PCB waste, including out-of-service date, in addition to RCRA hazardous waste labels. At a minimum, all PCB and hazardous waste labels shall bear the following information in English:

CAUTION
CONTAINS PCBs
[Out-of-Service Date – when PCB waste is first placed in drum]
HAZARDOUS WASTE
FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
HANDLE WITH CARE
[Generator Name, Address, and Telephone Number]
[Specific Contents of Container]
[EPA-Issued Generator Identification Number]
[EPA Waste Identification Number]
[Accumulation Start Date]

1. Since waste classification is pending analysis for RCRA/NYSDEC hazardous waste, the RCRA hazardous waste labels shall indicate "PCB/Hazardous Waste - Pending Analysis."

E. Sampling and Laboratory Analysis of PCB-Containing Wastes: For PCB Waste characterization, the PCB Waste Manager shall sample all potential PCB-Containing Waste Streams in accordance with the TSCA (40 CFR 761). According to the EPA, characterizing PCB-containing waste streams (i.e., determining whether wastes are regulated or non-regulated under TSCA) shall be made based upon the total PCB concentration at the "source" (e.g., the paint/bitumastic coating) prior to any disturbance that may be initiated through Abatement, removal, or construction/demolition activities. Unlike hazardous waste determinations that are made under RCRA (40 CFR 260 and 40 CFR 261), sampling to determine whether a waste is TSCA-regulated shall not be made based on the sampling and analysis of mixed bulk waste materials/debris generated as a result of Abatement, removal, or construction/demolition activities. Instead, source materials for PCBs must be collected as grab samples and must not be composited during collection or analysis as that may reduce the concentration of PCBs detected. Rather, individual source samples shall be submitted for analysis to determine the highest concentration of PCBs contained in the source material or wastes.

1. PCB concentrations are based on the cumulative total of the nine (9) Aroclor congeners (aka PCB compounds) analyzed by EPA Methods SW 846-8082A (soxhlet extraction method 3540) by Gas Chromotography.

2. If PCB concentrations in paints/coatings are present greater than or equal to 50 ppm, all PCB-containing waste generated during paints/coatings

disturbance will be classified as TSCA-regulated PCB waste. If PCB concentrations in paints/coatings are less than 50 ppm, all PCB-containing waste generated in the area will be classified as non-TSCA PCB-containing waste.

3. If it cannot be confirmed that the source of drummed waste (e.g., paints/coatings) is non-TSCA-regulated, or no source samples are available, or the soxhlet extraction method 3540 was not used for previous analyses, then four (4) biased worse-case grab samples shall be collected from the drum and each sample analyzed for Total PCBs. If any one grab sample result has a PCB concentration of equal to or greater than 50 ppm, the drummed waste shall be characterized as TSCA-regulated waste.

4. Waste materials/debris generated during Abatement, removal, or construction/demolition activities may be classified as RCRA or NYSDEC hazardous waste (6 NYCRR Part 370 and 6 NYCRR Part 371.4(e)) in addition to being TSCA-regulated. Therefore, wastes/debris must still be sampled and characterized prior to disposal. All waste samples shall be collected in the presence of the Engineer using the following procedure:

   a. Sampling of drummed waste will be biased for the worst-case (highest result) and will be based on inspection of drum contents. For drums with paint chips, with or without stripper waste, collect one grab sample for every quarter of the drum, from any hot spots (i.e., paint chips). As an example, if the drum is full, collect four grab samples, if the drum is half-full, collect two grab samples, and if the drum is one-tenth full, collect one sample. Grab samples shall be composited into one (1) bulk composite sample. For drums with PPE, polyethylene sheeting, rags, and towels, collect up to four (4) grab samples with positive bias for paint chips or paint-related staining. As such, samples are likely to be collected from dust or chips at the bottom of the drum. Each grab sample shall be composited into one (1) bulk composite sample, labeled, and submitted to a laboratory. Composite samples shall undergo Toxicity Characteristic Leaching Procedure (TCLP) analysis for the eight (8) RCRA metals and Total PCBs to determine if waste is a NYSDEC hazardous waste (i.e., listed waste B007), and any additional parameters that are required by the specific TSDF being used. Furthermore, if the waste stream is associated with the use of a chemical paint stripping system, the Contractor shall have the laboratory analyze each sample for pH and any other RCRA characteristic that may fail due to the chemical composition of the waste.

   b. One (1) representative wastewater sample shall be collected for laboratory analysis from each drum generated. Each sample shall be collected using appropriate field sampling equipment (e.g., a

pipette or bailer), and shall be labeled and submitted to a laboratory that satisfies the requirements of this Section.

F. Sampling and Laboratory Analysis of PCB-Containing Demolition Debris: The Contractor shall collect representative bulk samples of anticipated demolition wastes to determine proper disposal. In addition to a total PCB analysis of the source materials (e.g., paints/bitumastic coatings), representative bulk samples shall be collected from painted/bitumastic-coated building materials for TCLP analysis for the eight (8) RCRA metals and Total PCBs to determine if waste is a NYSDEC listed hazardous waste (i.e., listed waste B007).

1. Scrap Metal Exemption for Recycling: Under 6 NYCRR Part 371.1(c)(7), painted scrap metal can be sent to a recycling facility, rather than be discarded as hazardous waste. In order for DEP to submit a "c7 notification" to the NYSDEC and claim the "scrap metal exemption," the Contractor must first submit notification to their recycling facility indicating that PCBs are present on the scrap metal in concentrations less than 50 ppm. If concentrations are greater than or equal to 50 ppm, the scrap metal cannot be recycled and instead must be disposed of as a TSCA-regulated waste. If Lead or other heavy metals are detected in the paints/bitumastic coatings on the scrap metal, the Contractor shall also disclose this information to the recycling facility. The Contractor shall submit this documentation to the Engineer for approval prior to disposal.

G. Bulk demolition debris (e.g., painted concrete) that is sampled and determined to be non-RCRA-regulated and non-TSCA-regulated waste may be disposed of as construction and demolition (C&D) debris as per Section 01 74 20 – Construction Waste Management and Section 02 41 10 – Demolition and Removals.

H. Disposal of Wastes: The Contractor shall notify DEP at least 14 business days prior to the removal of any waste drums/containers. All waste profiles for containerized wastes must be reviewed by the Engineer and signed by DEP as the generator of the waste streams. As per 40 CFR Part 761.207, a Uniform Hazardous Waste Manifest shall be completed for TSCA-regulated and/or NYSDEC hazardous wastes. Wastes shall be disposed of to ensure that drums/containers do not remain on the job site for more than 90 calendar days from the initial "accumulation start date" on the label affixed to the drum/container. Containers that have reached their storage capacity shall not remain on site, and transportation arrangements shall be made for their immediate removal.

1. Small Capacitors and Fluorescent Light Ballasts: Small Capacitors and Fluorescent Light Ballasts are not classified as hazardous wastes under NYSDEC regulations (6 NYCRR 371.3(e)). However, these items are assumed to contain PCBs, and therefore must be disposed of as PCB Bulk Product Wastes unless marked "No PCBs" by the manufacturer. Small Capacitors and Fluorescent Light Ballasts that are not marked "No PCBs" or are leaking (regardless of PCB concentration), must be managed at one of the following facilities in accordance with 40 CFR 761.62(a): (a) in facilities using a TSCA-approved incinerator; (b) at a TSCA/RCRA-

permitted landfill; (c) in facilities using an approved alternate method of destroying PCBs; (d) at a facility using an approved method of removing/decontaminating PCBs; (e) using a TSCA PCB Coordinated Approval issued by the EPA Regional Administrator.

I. Disposal Documentation: If asbestos or lead (as defined in Section 02 82 05 - Asbestos Management and Section 02 83 05 - Lead Management) were detected in the wastes, the Contractor shall also ensure that the TSDF is approved by federal, state, and local regulatory agencies to receive these wastes. Once all waste profiles have been completed, the Contractor shall provide DEP with a "Letter of Acceptance" issued from the TSDF indicating that the wastes will be accepted, and a copy of the advance manifest. On the date of disposal, the Contractor shall submit one (1) copy of the completed manifest that has been signed and dated by the initial transporter in accordance with 6 NYCRR 372, 6 NYCRR 373, 40 CFR 262, 40 CFR 263 and 40 CFR 264, to DEP for signature as Generator. All waste containing PCBs must be identified on the manifest, including out of service date for hazardous waste manifests. All hazardous waste documentation (e.g., waste profiles, manifests, and Land Disposal Restrictions (LDRs)) must be signed by a DEP employee as described in Section 01 35 45 - Hazardous Materials Control. Non-hazardous waste documentation may be signed by a DEP-designated alternate.

END OF SECTION

SECTION 03 01 30.71 – REHABILITATION OF CAST-IN-PLACE CONCRETE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and appliances required for the complete execution of concrete rehabilitation to existing structures as indicated on the Contract Drawings, determined by field survey directed by the Engineer and in accordance with the requirements specified herein.

B. Principal items of Work include:

1. The Contractor shall determine by field survey, in conjunction with the Engineer, the extent of concrete to be repaired, stabilized and resurfaced. Areas to be replaced or modified by new work shall not be included. Report of field survey shall be submitted by the Contractor to the Engineer for review and approval prior to starting work.

2. Preparation for repairing, stabilizing and resurfacing exterior and interior cast-in-place concrete floors, walls, ceilings, platforms, steps, footings and the like.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Implementation	8
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 32 00 - Joints in Concrete

B. Section 07 90 00 - Joint Protection

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1. ASTM C33 - Concrete Aggregates.

2. ASTM C881 - Epoxy-Resin Base Bonding System for Concrete.

3. ACI 503.4 - Standard Specification for Repairing Concrete with Epoxy Mortars.

4. ISO 14025 - Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. Services of Manufacturer’s Representatives

1. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane, polymer-modified and cement-based compounds.

2. The manufacturers' representative shall provide written certification that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

3. The onsite time required for the manufacturer's representative to achieve a successful installation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Resident Engineer and provide written verification of the areas he has approved on each day he is at the project.

1.06 QUALITY ASSURANCE

A. The Contractor shall furnish the name of all subcontractors which he proposes to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

B. Approved applicator qualifications shall include:

1. A minimum of five years of experience in applying epoxy, polyurethane and polymer-modified and cement-based compounds similar to those specified in this Section.

2. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Proposed methods and corresponding area to be repaired.

2. Samples of all materials proposed to be used.

3. Material certifications and technical data sheets on all grouts, mortars, chemical resins, sealers, aggregates and repair products specified.

4. Name, address and detailed qualifications of firm to which the Contractor intends to award the work under this Section.

B. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor’s approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification

Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in original unopened and undamaged cartons or packing bearing the name of manufacturer.

B. Cementitious materials shall be stored in waterproof locations to prevent intrusion of moisture and other damage from the elements. Containers showing evidence of damage will be rejected.

C. Aggregates shall be stored in separate bins to prevent mixing with foreign particles.

D. Any materials that have hardened, partially set, become caked and/or been contaminated or deteriorated shall be rejected.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The epoxy bonding agent resin shall be:

1. Sika Armatec 110 as manufactured by Sika Corp. Lyndhurst, NJ;
2. CR 246 as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duralbond as manufactured by Tamms Industries Co., Kirkland, IL;
4. Or approved equal.

B. Anti-corrosion coating material shall be:

1. Sika Armatec 110 as manufactured by Sika Corp., Lyndhurst, NJ;
2. CR 246 manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Or approved equal.

C. Structural crack repair material shall be:

1. Sikatop 123 Plus as manufactured by Sika Corp., Lyndhurst, NJ;

2. CR 735 Trowel-Grade Mortar as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duraltop Gel as manufactured by Tamms Industries, Kirkland, IL;
4. Or approved equal.

D. Epoxy crack repair binder shall be:

1. Sikadur 35-Hi-Mod LV as manufactured by Sika Corp., Lyndhurst, NJ;
2. CR 633 Epoxy Binder as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duralcrete LV as manufactured by Tamms Industries, Kirkland, IL;
4. Or approved equal.

E. Hydrophilic injection grout shall be:

1. Hydro-Active Flex LV as manufactured by De Neef Construction Chemicals, Houston, TX;
2. Prime Flex 900 LV as manufactured by Prime Resins, Conyers, GA;
3. Scotch Seal 5600 Chemical Grout as manufactured by 3M Construction Markets, St. Paul, MN;
4. Or approved equal.

F. Hydrophobic injection grout shall be:

1. Hydro-Active Cut as manufactured by De Neef Construction Chemicals, Houston, TX;
2. Prime Flex 920 as manufactured by Prime Resins, Conyers, GA;
3. Sikafix HH as manufactured by Sika Corp., Lyndhurst, NJ;
4. Or approved equal.

G. Spall repair mortar for use in horizontal applications not requiring formwork shall be:

1. Sikatop 122 Plus as manufactured by Sika Corp., Lyndhurst, NJ;
2. CR 700 as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duraltop Fast Set as manufactured by Tamms Industries, Kirkland, IL;
4. Or approved equal.

H. Spall repair mortar for use in vertical applications not requiring formwork shall be:

1. Sikatop 123 Plus as manufactured by Sika Corp., Lyndhurst, NJ;
2. CR 702 as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duraltop Gel as manufactured by Tamms Industries, Kirkland, IL;

4. Or approved equal.

I. Spall repair mortar requiring formwork shall be:

1. Sikatop 111 Plus as manufactured by Sika Corp., Lyndhurst, NJ;
2. CR 730 as manufactured by Sto Concrete Restoration Division, Atlanta, GA;
3. Duraltop Flowable Grout as manufactured by Tamms Industries, Kirkland, IL;
4. Or approved equal.

J. Waterproof membrane patch sealing system shall be:

1. Sikadur Combiflex as manufactured by Sika Corp., Lyndhurst, NJ;
2. Or approved equal.

K. Cement based textured coating shall be:

1. Sikatop 144 as manufactured by Sika Corp., Lyndhurst, NJ;
2. Duraltop Coating as manufactured by Tamms Industries, Kirkland, IL;
3. Thoroseal/Acryl 60 as manufactured by Thoro System Products, Folcroft, PA;
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Water

1. The water used for mixing concrete repair products shall be clear, potable and free of deleterious substances.

B. Aggregate

1. All aggregates shall conform to ASTM C33 and the requirements listed below:
   a. Pea Gravel: Pea gravel shall meet the gradation of New York State size #9 and meet all material requirements specified in Section 703 for coarse aggregate as described by the New York State Department of Transportation Standard Specifications and shall be clean and free from deleterious matter. Pea gravel shall contain no limestone.

C. Epoxy Bonding Agent

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.

D. Anti-Corrosion Coating

1. Anti-corrosion coating shall be a two-component, polymer-modified cementitious material.

E. Structural Crack Repair Material

1. Structural crack repair material shall be a two-component, polymer-modified cementitious mortar and shall conform to EPA/USPHS standards for surface contact with potable water supplies.

F. Epoxy Crack Repair Binder

1. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive designed for structural repair.

G. Flexible Polyurethane Hydrophilic Injection Grout Crack Repair Material

1. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

H. Rigid Polyurethane Hydrophobic Injection Grout Crack Repair Material

1. Rigid polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophobic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough rigid foam seal that is impenetrable to water.

I. Spall Repairs Mortar Not Requiring Formwork

1. Spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi.

2. All spall repair materials shall conform to EPA/USPHS standards for surface contact with potable water supplies.

J. Spall Repairs Mortar Requiring Formwork

1. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 6000 psi. Each unit of mortar shall be mixed with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

2. All spall repair materials shall conform to EPA/USPHS standards for surface contact with potable water supplies.

K. Waterproof Membrane Patch

1. Waterproof membrane patch shall be a hypalon sealing strip secured to the concrete substrate with an epoxy adhesive.

2. Sealing system shall be installed per manufacturer's recommendations.

L. Sealant

1. Sealant shall be a two-component polyurethane sealant as specified in Section 07 90 00 – Joint Protection. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

M. Expansion Joint Filler

1. Expansion joint filler shall be as specified in Section 03 32 00 – Joints in Concrete.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. General Requirements

1. All exterior Work shall be performed during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. All unfinished Work shall be protected during inclement weather with tarpaulins or heavy gage polyethylene sheeting.

2. All Work in spaces within structures shall be performed at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

3. Concrete rehabilitation Work shall be coordinated and sequenced by the Contractor. Scaling, broken, loose and disintegrating materials shall be removed by use of hand tools or power driven saws, down to solid unyielding material.

4. Scaling, broken, loose, and disintegrating materials shall be removed by use of hand tools or power driven saws, down to solid unyielding material.

5. All surfaces shall be thoroughly cleaned of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

B. Epoxy Bonding Agent

1. As directed by the Engineer, an epoxy bonding agent shall be used to adhere fresh concrete to existing concrete. Existing concrete surfaces shall be roughened prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material

shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.

2. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4, and as specified herein.

C. Anti-corrosion Coating

1. Reinforcing steel cut or exposed during alteration and/or repair operations shall be sandblasted, cleaned and coated with an anti-corrosive coating.

2. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

D. Structural Crack Repair

1. As directed by the Engineer, all existing structural cracks 1/16 inch and wider to be repaired shall utilize a structural crack repair material. Rout crack to 3/4 inch wide by 3/4 inch deep V-notch to expose sound concrete.

2. Where rebar has deteriorated, crack shall be routed to expose 3/4 inch all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using structural crack repair material.

E. Epoxy Crack repair

1. Cracks 1/4-Inch and Narrower: As directed by the Engineer, all existing structural cracks 1/4-inch or narrower to be repaired shall be pressure injected an epoxy crack repair binder into the prepared crack. Crack surface shall be sealed and injection ports installed per manufacturer's recommendations.

   a. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete.

   b. Once the surface sealing material has cured, inject crack with epoxy crack repair binder using pressure injection equipment as directed by the manufacturer.

2. Cracks wider than 1/4-Inch: As directed by the Engineer, all existing structural cracks wider than 1/4 inch to be repaired shall be gravity fed an epoxy crack repair binder into the prepared crack.

   a. Concrete surface shall be routed to form a minimum 1/4 inch wide by 1/4 inch deep V-notch and the crack cleaned to remove all loose and foreign particles. Crack shall be filled with clean, dry sand and then epoxy crack repair binder poured into V-notch, completely filling crack.

   b. As binder penetrates into crack, additional binder shall be applied to the V-notch.

F. Rigid and Flexible Polyurethane Crack Repair

1. As directed by the Engineer, all existing, leaking cracks 1/4 inch and narrower to be repaired shall be pressure injected with a waterproof hydrophilic or hydrophobic injection grout into the prepared crack. Crack surface shall be sealed and injection ports installed per manufacturer's recommendations.

2. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete.

3. Once the surface sealing material has cured, inject crack with waterproof hydrophilic or hydrophobic injection grout using pressure injection equipment as directed by the manufacturer.

G. Spall Repair

1. As directed by the Engineer, all voids or spalled areas to be repaired shall be chipped back a minimum of 1/8-inch to sound concrete and the area cleaned and repaired to original dimensions with spall repair patching material according to manufacturer's recommendations.

2. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface.

3. Final patching on horizontal surfaces shall receive a finish consistent with the finish on the existing structure.

H. Expansion Joint Repair

1. Remove all sealant and breaker and joint filler.

2. Remove all unsound concrete on the joint faces as directed by the Engineer.

3. Remove all laitance and provide a clean dry surface.

4. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following manufacturer's instructions.

5. Restore surface to original dimensions by trowelling epoxy mortar onto the existing substrate in a manner to ensure bonding following manufacturer's instructions.

6. Cure repair following manufacturer's instructions.

7. Replace joint filler and sealant as indicated on the Contract Drawings.

I. Waterproof Membrane Patch

1. As directed by the Engineer, existing concrete areas requiring a textured patch shall be thoroughly cleaned and the waterproof membrane patch applied according to manufacturer's recommendations.

J. Cement Based Textured Coating

1. As directed by the Engineer, existing concrete areas requiring a textured coating shall be thoroughly cleaned and the cement based textured coating applied according to manufacturer's recommendations.

2. All other concrete rehabilitation work as directed by the Engineer shall be completed prior to applying coating.

K. Curing

1. All repair materials utilized shall be cured in strict accordance with manufacturer recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Pumps and hoses used for crack repair shall be completely flushed. A sharp sided tool such as a putty knife or trowel shall be used to remove excess material from walls, floors, etc. Material shall be cured before removing.

B. The uncured polyurethane chemical grout shall be cleaned from tools with an approved solvent. The cured polyurethane chemical grout can only be removed mechanically.

C. The uncured polymer-modified Portland cement mortar shall be cleaned from tools with water. The cured polymer-modified Portland cement mortar can only be removed mechanically.

D. Excess materials caused by work under this Section shall be cleaned from existing surfaces by the use of power sanders and the surfaces shall be vacuumed clean and readied to receive final cleaning and finishing specified in other Sections. All cracks shall be sanded and shall lie in the same plane as adjacent surfaces.

E. Misplaced sealants shall be removed using methods and materials recommended by the manufacturers, and the finished work and work area shall be left in a neat and clean condition.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Work specified in this Section consists of designing, furnishing materials for, fabricating, erecting, and removing formwork, falsework and shoring for cast-in-place concrete as indicated on the Contract Drawings, specified herein and needed for a complete installation.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Implementation	10
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	15
3.05	Adjusting / Protection / Cleanup	15

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 03 35 00 - Concrete Finishing

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1. ACI 117 - Standard Tolerances for Concrete Construction and Materials
2. ACI 303 - Guide to Cast-in-Place Architectural Concrete Practice
3. ACI 347 - Guide to Formwork for Concrete
4. ACI SP-4 - Formwork for Concrete
5. American Plywood Association (APA): APA Grade - Trademark
6. ISO 14025 - Environmental labels and declarations - Type III environmental declarations
7. New York City Building Code
8. Western Wood Products Association (WWPA): Western Lumber Product Use Manual

1.05 DESCRIPTION

1. Formwork materials shall be protected before, during, and after erection to insure acceptable finished concrete Work. In-place materials and other operations of Work in connection with concrete pours shall be protected.
2. In the event of damage to erected forms, necessary repairs or replacements prior to concrete pours shall be performed at no expense to DEP.
3. The Contractor shall allow sufficient time, as determined by the Engineer from the approved schedule, between erection of forms and placing of concrete for the various trades to properly install their Work.
4. External or superimposed loads, lateral or vertical, shall not be applied on casting concrete until concrete has developed specified 28-day compressive strength and reached the minimum curing age required by Section 03 30 00-Cast-in-Place Concrete.
5. Stay-in-place forms are not permitted unless otherwise shown on the Contract Drawings or approved by the Engineer.

B. Design of Formwork:

1. Formwork shall be designed and constructed in compliance with ACI SP-4 and, if applicable, ACI 303.
2. The Contractor shall assume responsibility for the design, engineering, and construction of formwork. Forms shall be designed to produce concrete

members identical in shape, lines, and dimensions to members shown on the Contract Drawings.

3. The formwork shall be designed for the loads and lateral pressures in accordance with ACI 347 and wind loads as specified by the New York City Building Code.

4. Construction and control joints, openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, waterstops, anchorages, inserts, and other features shall be provided as required.

5. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

6. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.

7. Formwork surface materials shall meet the requirements of Section 03 35 00 - Concrete Finishing.

1.06 QUALITY ASSURANCE

A. Unless otherwise noted on the Contract Drawings, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.

B. A full size mock-up of a cast-in-place wall shall be erected on the Site where directed. Mock-up shall conform to requirements of Section 03 35 00 - Concrete Finishing.

C. Shop Drawings approvals shall be obtained before custom fabrication is started and before delivery of materials to the Site.

D. Work of this Section shall be coordinated with the work of other trades so that construction is not delayed.

E. Formwork erection procedures and health and safety of the work force shall be the responsibility of the Contractor. The requirements of authorities having jurisdiction shall be complied with.

F. Errors of detailing and fabrication and the correct fit of the formwork shall be the responsibility of the Contractor.

G. Materials, fabrications, and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional expense to DEP.

H. Design of formwork layout, spans, fastenings, joints, and framed openings shall be under the direct supervision of a Professional Engineer, who is licensed and

registered in the State of New York with minimum of 10 years of experience in structural design of formwork.

1.07 SUBMITTALS

A. Shop Drawings submitted for approval of the Engineer shall include, but not be limited to, the following data:

1. Design of all field-constructed and prefabricated formwork. The Contractor shall submit drawings and calculations signed and sealed by a professional engineer licensed in the State of New York for form designs and re-shoring.

2. For each type of form required, material type, material thickness, finish, and a dimensional cross-sectional profile.

3. Details of erection, including various connections, layouts of form units placement directions, anchoring and support details, attachment of accessories, each condition requiring enclosures, cut opening, special jointing, and other accessories as required to complete the work.

B. Manufacturer's specifications and installation instructions for each type of required formwork and accessory shall be submitted. These include each type of sheeting, chamfer strips, form facing materials, form ties, form liners, rustication strips, form release agent, dovetail anchor slots, form coating material, form caulking, and similar items.

C. Plan for Reshoring: When reshoring is permitted or required, the operations shall be planned in advance and in accordance with acceptable procedures and the requirements of this Section.

1. The Contractor shall submit as a part of the shop drawings a Plan for Reshoring prepared and sealed by a New York State registered professional engineer.

D. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor’s approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification

Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the work.

B. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure. The maximum uniform distributed storage load shall not exceed 20 pounds per square foot.

C. Material shall be handled safely in a manner that will prevent distortion or other damage. Care shall be exercised at all times to avoid damage through careless handling during unloading, storing and erecting. Panels shall be supported by using strong backs while lifting panels in a horizontal position.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. A-2 Cone Snap-in Form Tie shall be as manufactured by:

1. Dayton Superior.
2. Williams Form Engineering Corp.
3. Symons Corp.
4. Or approved equal.

B. Form caulking shall be as manufactured by:

1. Series 1200 Construction Caulking; GE Silicones/Momentive Performance Materials, Inc., Waterford, NY.

2. Dow Corning 999-A; Dow Corning Co., Auburn, MI.
3. Or approved equal.

C. Form release agent shall be as manufactured by:
1. Specco F-100; Specco Industries, Inc., Lemont, IL.
2. Debond Form Coating; L&M Construction Chemicals, Inc., Omaha, NE.
3. Magic Kote; Symons Corporation, Des Plaines, IL.
4. Or approved equal.

D. Form film shall be as manufactured by:
1. Symons Corporation, Des Plaines, IL.
2. Or approved equal.

E. Form liners shall be as manufactured by:
1. Dura-Tex; Symons Corporation, Des Plaines, IL.
2. Or approved equal.

F. Rustications shall be as manufactured by:
1. Symons Corporation, Des Plaines, IL.
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Lumber
1. Only stress-grade lumber shall be provided. Form framing, sheathing and shoring shall conform to WWPA Western Lumber Product Use Manual.
2. For lumber in contact with concrete, the lumber shall be provided with dressed or tongue-and groove edges on at least the side contacting the concrete, unless otherwise indicated on the Contract Drawings.

B. Plywood
1. Only grade-marked plywood conforming to APA shall be provided.
2. B-B Plyform, Exterior Class 1 or 2, or High Density Overlay (HDO) form plywood, Class 1 or 2 conforming to U.S. Product Standard PS-1 shall be provided.
3. Thickness shall be as required to maintain alignment and surface smoothness, but not less than 5/8 inch thick.

C. Steel Forms
1. Commercial grade sheets not less than 16 gage shall be provided.

2. Steel forms in rust-free condition shall be maintained by use of steel wool and light grinding, followed by coats of the specified release agent.

3. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

4. Panels shall be fabricated in conformance with the approved submittals.

5. Outward facing surfaces shall be reinforced as required to prevent warpage and deformation during concrete placement.

D. Form Ties

1. Commercially manufactured type form ties, hangers, and clamps of such type that, after removal of the forms, metal will not be closer than concrete cover as indicated on the Contract Drawings from concrete surface shall be provided. Non-fabricated wire ties will not be permitted.

2. A cone-shaped, snap-in type form tie suitable for the intended use with a working load as required and an integral hot forged head shall be provided.

3. Ties with swaged washers or other suitable devices to prevent seepage of fluid along the ties shall be provided. Ties shall be left in place. She-bolt with water seals shall be provided.

4. Form ties for all liquid-retaining structures shall have waterstop at mid-thickness of wall.

5. Lugs, cones, washers, or other devices which do not leave holes or depressions greater than 1-inch in diameter shall be provided.

E. Chamfer Strips

1. 3/4 inch by 3/4 inch triangular fillets shall be provided, all of which shall be milled from clear, straight-grain pine, surfaced each side, or all of which shall be extruded vinyl type with or without nailing flange unless otherwise indicated on the Contract Drawings.

F. Inserts

1. Galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps shall be provided.

G. Dovetail Anchor Slots

1. Dovetail anchor slots manufactured from 22 gage, electro-galvanized steel with removable felt or polyurethane filler shall be provided, where indicated on the Contract Drawings.

H. Shop Fabricated Form

1. Forms shall be fabricated in accordance with the approved submittals.

2. Forms shall be maintained clean, smooth, and free from imperfections and warpage.

3. Locate joints as indicated on the approved Shop Drawings.

   a. Form panels shall be arranged in symmetrical patterns conforming to the general lines of the structure.

   b. Except when otherwise indicated on the Contract Drawings, panels on vertical surface shall be oriented with the long dimension horizontal joints level and continuous.

   c. Form panels on each side of the panel joint shall be precisely aligned by means of fasteners common to both panels, to result in a continuous, unbroken concrete surface.

   d. Largest stock size practicable shall be provided.

   e. Between form joints, areas less than the stock size of the form liner material shall be lined with a single piece of liner material.

I. Form Caulking

1. Form caulking shall be a one-component, gun-grade silicone sealant that is capable of producing flush, watertight and non-absorbent surfaces and joints. Sealant shall be compatible with the type of forming material and concrete ingredients used.

J. Form Release Agent

1. Form release agent shall be a VOC compliant commercial formulation form-coating compound that will not bind with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compounds. Form release agent shall be a nonreactive type as approved by ANSI/NSF standard 61.

K. Form Film

1. Form film shall conform to the requirements of form release agent above.

   a. Thinner shall be provided as recommended by manufacturer of the form film.

L. Form Liners

1. Form liners shall be provided as required to create the finishing, texture, and configuration as shown on the Contract Drawings.

M. Rustications

1. Rustications shall be provided as required to create the finishing, texture, and configuration as shown on the Contract Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements

1. Prior to commencement of the Work, existing dimensions, elevations, locations and conditions applicable to the Work shall be field verified. Variances and discrepancies from the Contract Drawings and potential interferences shall be reported promptly to the Engineer.

2. Sufficient field measurements shall be taken prior to preparation of Shop Drawings and fabrication of construction materials, where possible, to ensure proper fitting of the work. However, job progress shall not be delayed. The Contractor shall allow for adjustments and fittings wherever the taking of field measurements before fabrication may not be possible or might delay the work.

3. Actual field-verified conditions may require modifications to the fabrication and/or erection details as indicated on the Contract Drawings. The Work shall be performed to meet actual field conditions encountered.

B. Preparation

1. The Contractor shall examine the areas and conditions under which the Work of this Section is to be performed. Conditions detrimental to the proper and timely completion of the Work shall be corrected. Work shall not proceed until unsatisfactory conditions have been corrected. Prior to placement of concrete, forms shall be inspected for cleanliness and accuracy of alignment.

2. Earth cuts shall not be used as forms for vertical surfaces, unless noted on the Contract Drawings.

3. Where different levels are indicated for wall footings, the footings shall be stepped. Unless otherwise indicated on the Contract Drawings, steps in wall footings shall not be of greater height than the thickness of the footings and steps shall not lap less than 6 inches. No form shall be set at the back of such steps and where earth has slumped off in such locations it shall be cut back to a vertical plane just before the concrete is placed.

3.02 IMPLEMENTATION

A. Erection and Installation

1. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and all joints and seams shall be made mortar-tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise noted on the Contract Drawings, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits in ACI 117.

2. The size and spacing of studs and wales shall be determined by the nature of the work and the height to which concrete is placed. Forms shall be made adequate to produce true, smooth surfaces.

3. Forms shall be supplied for repeated use in sufficient number to ensure the required rate of progress. Forms shall be cleaned and inspected immediately prior to depositing concrete. Deformed, broken or defective forms shall be removed from the work.

4. Joints shall be snug and tight and shall occur only at the designated locations. Construction and control joints other than those shown on the Contract Drawings shall be approved by the Engineer. Horizontal joints shall be level, and vertical joints shall be plumb. Joints shall be made perpendicular to the main reinforcement except where otherwise indicated on the Contract Drawings.

5. Temporary openings shall be provided where interior area of formwork is inaccessible for cleanout or inspection before concrete placement, and for placement of concrete. Temporary openings shall be securely braced and set tightly to forms to prevent the loss of concrete mortar. Temporary openings shall be located on forms in locations as inconspicuous as possible consistent with the requirements of the work.

6. Openings shall be provided in concrete formwork of the correct size and in the proper location to accommodate other operations of construction work in the project. Expansion joint material, waterstops, and other embedded items to be built into forms shall be accurately placed and securely supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

7. Edge forms or bulkheads and intermediate screed strips for slabs shall be set to obtain required elevations and contours in the finished slab surface.

8. Forms shall be set sufficiently to prevent joints in wood forms from opening prior to concrete pour.

9. Cutting form ties back from the face of the concrete shall not be permitted.

10. Formwork shall be observed continuously while concrete is being placed to see there are no deviations from desired elevation, alignment, plumbness and camber. If, during casting, weakness develops and the formwork shows settlement, deflection or distortion, the Work shall be stopped, improperly cast concrete shall be removed and the formwork shall be reconstructed to perform properly.

    a. Forms for columns, beams, girders, walls and window openings shall be erected in accordance with ACI 117, with a maximum camber of 3/4-inch in 20 feet. Column sides shall be clamped with metal column clamps, or equal, spaced according to manufacturer's recommendation. Exposed external angles of columns, beams, girders and walls, except where specially shown on the Contract Drawings shall be provided with 3/4-inch bevel strips securely nailed on all concrete formwork including concrete encasement of structural steel shapes.

11. Form release agents shall be applied in accordance with manufacturer's instructions and as specified herein:

    a. Form contact surfaces shall be coated with form release agent compound before reinforcement is placed. Excess form release agent material shall not be allowed to accumulate in the forms or to come into contact with surfaces which are required to be bonded to fresh concrete such as concrete reinforcement and embedded items.

    b. Steel forms shall be coated with non-staining, rust-preventive form oil or otherwise shall be protected against rusting. Rust-stained steel surfaces in contact with concrete shall not be used.

12. Excess form coating material shall not be allowed to accumulate in the forms.

13. Form coatings shall not be allowed to come in contact with construction joints or reinforcing steel.

14. Runways for moving equipment shall be provided with struts or legs and supported directly on the formwork or structural member without resting on the reinforcing steel.

15. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

16. All sleeves, inserts, anchors, and embedded items required for adjoining work or for support of joining work shall be placed prior to concreting.

17. Architectural Formwork:

    a. Form liners and rustication strips shall be installed in strict accordance with the manufacturer's written instructions and recommendations. The ends of the form liner pattern shall be clogged and all form joints and edges shall be taped using 1/8-inch thick by 3/4-inch wide foam tape centered on the joints, then caulked in accordance with the manufacturer's recommendations each time forms are set. A representative of the manufacturer shall be present at the site to supervise the installation of the form liner for the entire project.

    b. Forms for smooth concrete shall be installed in such a manner that there will be no horizontal form joints, and the forms shall be aligned so that vertical joints occur only at "V-Groove" rustications. Form ties shall be spaced in a uniform pattern vertically and horizontally. Form ties shall be positioned in smooth concrete bands and in panels between "reveal" rustications, if any.

    c. Beam and girder soffits shall be erected in accordance with ACI 117 and sufficiently braced, shored, and wedged to prevent deflection. Column sides shall be clamped in accordance with this specification with metal column clamps, spaced according to the manufacturer's directions.

B. Reshoring

1. During reshoring the concrete in beams, slabs, columns, or any other structural members shall not be loaded with combined dead and construction loads in excess of the loads permitted by the Engineer for the developed concrete compressive strength at the time of reshoring.

2. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

3. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise noted on the Contract Drawings.

4. For floors supporting shores under newly placed concrete, the original supporting shores or reshores shall be left in place. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and in

all cases shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under the floors supporting shores unless other locations are permitted or shown on the Contract Drawings.

5. In multi-story buildings reshoring shall be extended over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

C. Removal of Forms and Ties

1. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties and bracing shall not be removed without specific permission of the Contractor's Registered Professional Engineer.

2. Top forms on sloping surfaces of concrete shall be removed as soon as removal operations will not allow the concrete to sag. Any needed repairs or treatment required on sloping surfaces shall be performed at once and shall be followed immediately with the specified curing.

3. Upon removal of forms, the Engineer shall be notified in order that a review of the newly stripped surfaces may be made before patching.

4. Wood forms for wall openings shall be loosened without causing damage to the concrete. The face of concrete shall not be pried against. Only wooden wedges shall be used.

5. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured in accordance with one of the methods specified in Section 03 30 00 - Cast-in-Place Concrete.

6. In general, forms shall not be removed until the concrete has hardened sufficiently to safely support its own load, plus any superimposed load that might be placed thereon. As a minimum the forms shall be left in place for the length of time and until the concrete has achieved the minimum strength as specified below. These times represent cumulative days, not necessarily consecutive, during which the air surrounding the concrete is above 50 degrees F.

	Min Time (days)	**Min Strength (psi)**
1. Curbs and Walks	2	1500
2. Columns	2	2000

	Min Time (days)	Min Strength (psi)
3. Side forms for girders and beams	2	2000
4. Walls	2	2000
5. Bottom forms of slabs:		
a. Under 20 feet clear span	7	3000
b. Over 20 feet clear span	10	3500
6. Bottom forms of beams and girders:		
a. Under 10 feet clear span	7	3000
b. 10 to 20 feet clear span	14	3500
c. Over 20 feet clear span	21	4000

a. These times shall be increased if the concrete temperature following placement is permitted to drop below 50 degrees F.

7. Care shall be taken in removing forms, wales, shorings, supports and form ties to avoid spalling or marring the concrete. Rubbed finish, if required, and such patching as may be necessary shall be started immediately after removal.

D. Re-Use of Forms

1. Forms for re-use shall meet requirements for new forms with respect to effect on cast-in-place concrete appearance and structural stability.

2. Re-use of forms shall in no way delay or change the concrete placement schedule as compared to the schedule obtainable if all forms were new (in the case of wood forms) of if the total required forms were available (in the case of metal forms).

3. Formwork shall be cleaned and re-oiled prior to re-use. Plywood forms shall not be re-used if unused holes from form ties exist from a previous use. High density overlay plywood panels shall be thoroughly cleaned and lightly recoated before each additional use. Wood forms shall not be used more than three times.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

2. The surface of installed forms shall not be overloaded.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 03 21 00 - REINFORCING STEEL

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install all reinforcing steel as indicated on the Contract Drawings including all labor, materials, hardware, equipment, transportation, and services required for fabricating, cutting, bending, fastening and any special work and supplies necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this Section and needed for a complete installation as approved by the Engineer.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	12
PART 3	EXECUTION	12
3.01	Examination / Preparation	12
3.02	Implementation	12
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	18
3.05	Adjusting / Protection / Cleanup	18

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 – Sustainability Certification Project Requirements

B. Section 03 30 00 - Cast-In-Place Concrete

C. Section 03 41 00 - Precast Structural Concrete

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

2. Global Warming Potential (GWP) – Measure of how much a specific greenhouse gas contributes to global warming compared to carbon dioxide (CO2) over a given time period, usually 100 years.

B. Reference Standards

1. ACI 301 - Specifications for Structural Concrete for Buildings

2. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

3. ACI 315 - Guide to Presenting Reinforcing Steel Design Details

4. ACI 318 - Building Code Requirements for Reinforced Concrete

5. ACI SP66 - Detailing Manual

6. AWS D1.4 - Structural Welding Code - Reinforcing Steel

7. ASTM A82 - Steel Wire, Plain, for Concrete Reinforcement

8. ASTM A184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

9. ASTM A 1064 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

10. ASTM A496 - Steel Wire, Deformed, for Concrete Reinforcement.

11. ASTM A497 - Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

12. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

13. ASTM A616 - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

14. ASTM A617 - Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
15. ASTM A706 - Low-Alloy Steel Deformed Bars for Concrete Reinforcement
16. ASTM A767 - Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
17. ASTM A775 - Epoxy-Coated Reinforcing Steel Bars.
18. CRSI DA4 - Concrete Reinforcing Steel Institute Manual of Standard Practice
19. ISO 14025 - Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. Placing drawings showing all dimensions necessary for fabrication and placing of the reinforcing steel and accessories without reference to the Project drawings shall be submitted for approval. Approval shall be obtained from the Engineer before fabrication.

B. Details of concrete reinforcement not covered in the Contract shall be in accordance with ACI 315, ACI 318 and CRSI DA4.

C. When it is found necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, a submittal showing the resulting arrangement of reinforcement shall be submitted to the Engineer for approval.

D. All reinforcement, at the time concrete is placed, shall be free of mud, oil or other materials that may adversely affect or reduce the bond. Reinforcement with rust, mill scale or a combination of both shall be considered satisfactory provided the minimum dimensions, weight and height of deformation of a hand-wire-brushed test specimen are not less than the applicable ASTM Specification requirement.

E. Provide accurate templates for column dowels to secure their position and to ensure their proper placement in concrete, unless otherwise approved by the Engineer.

1. To obtain approval to place column dowels without using templates, the Contractor must submit:

   a. Request for such approval with details on how column dowels will be secured in their position; and

   b. Placing drawings as specified herein.

2. The Engineer reserves the right to grant approval to place column dowels without using templates based on review of the placing drawing submittal. The Engineer's determination on use of templates will be final, and the Contractor shall abide by such determination.

F. All splices shall be as indicated on the Contract Documents unless otherwise permitted by the Engineer. Mechanical connections that provide a minimum of 125 percent of the yield strength of the reinforcing bars may be used when permitted by the Engineer.

1. Reinforcement coating shall be removed in the area of the mechanical connection, if so required by the connection manufacturer.

2. After installation of mechanical connections on zinc-coated (galvanized) or epoxy-coated reinforcing bars, coating damage shall be repaired in accordance with the requirements of this Section. All external parts of mechanical connections used on coated bars, including steel splice sleeves, bolts and nuts shall be coated with the same material used for repair of coating damage.

G. Temperature Reinforcing

1. Unless otherwise shown on the Contract Drawings or in the absence of the concrete temperature reinforcing being shown:

a. The minimum cross sectional area of horizontal and vertical concrete temperature reinforcing in walls shall be 0.0033 times the gross concrete area.

b. The minimum cross sectional area of temperature reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area.

2. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

H. Sustainability Performance Requirements

1. The Global Warming Potential of fabricated reinforcing steel bars shall not exceed 0.8 KgCO2e/kg.

1.06 QUALITY ASSURANCE

A. All reinforcement shall be supported and fastened before concrete is placed and shall be secured against displacement within the tolerances permitted in this Section.

1.07 SUBMITTALS

A. The Contractor shall submit placing drawings, Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not limited to:

1. Detailed placement and shop fabrication drawings, prepared in accordance with ACI 315 and ACI SP66 shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint

locations, openings, and the arrangement, layout, bending, assembly diagrams, bar schedules, spacing, lapping and splicing of the bars.

2. Certified copies of mill reports shall accompany all deliveries of reinforcing steel.

3. Description of the reinforcing steel manufacturer's marking pattern.

4. Description of proposed supports for each type of reinforcing.

5. Description of reinforcing weld locations and weld procedures.

6. Adhesive dowel testing plan, including proposed testing procedures and equipment, test load value, and testing results in accordance with 1.06.

B. The Contractor shall also include the following:

1. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

2. Request to use splices not shown on the Contract Drawings.

3. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.

4. Request for placement of column dowels without the use of templates.

5. Request and procedure to field bend or straighten partially embedded reinforcing.

6. Request to use hooked anchorage systems, dowel bar substitute systems, and dowel bar sleeves, along with manufacturer’s literature and instruction for installation, and certified test reports.

C. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor’s approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop

drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Coating damage zinc-coated (galvanized) reinforcing bars due to handling, shipping and placing shall be repaired in accordance with the requirements of this Section.

C. Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. Coating damage due to handling, shipping and placing shall be repaired in accordance with the requirements of this Section.

D. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

E. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

F. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be re-inspected and if necessary re-cleaned.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Reinforcing Steel:

1. Nucor Corporation, Charlotte, NC
2. ArcelorMittal, Chicago, IL

3. Gerdau, Tampa, FL.
4. Or approved equal.

B. Dowel Adhesive System

1. The adhesive system shall be:
   a. HIT RE-500 V3 Injectable Mortar EpoxyAdhesive as manufactured by Hilti, Inc., Plano, TX.
   b. Epcon System as manufactured by ITW Ramset/Redhead, Glendale Heights, IL.
   c. Sikadur Injection Gel as manufactured by Sika Corp., Lyndhurst, NY.
   d. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Reinforcement

1. Reinforcing Steel:
   a. All reinforcing steel shall be deformed except spirals and welded wire fabric, which may be plain bars. Reinforcement shall be the grades required by the Contract Documents and shall conform to one of the following specifications:
      1) ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
      2) ASTM A616 - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement (including supplementary requirements S1).
      3) ASTM A617 - Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
      4) ASTM A706 - Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
      5) Wire or wire fabric with a specified yield strength fy exceeding 60,000 psi shall have the stress fy corresponding to a strain of 0.35 percent.
      6) Reinforcing steel shall conform to the applicable requirements of Sections 03 30 00 – Cast-in-Place Concrete, 03 41 00 - Precast Structural Concrete and the New York City Building Code.
2. Coated Reinforcing Bars:

a. Furnish and install coated reinforcing bars for structural concrete Work wherever shown and/or noted on the Contract Drawings.

b. Reinforcing bars shall be zinc-coated (galvanized) or epoxy-coated. The reinforcing bars to be coated shall conform to the requirements of this Section.

1) Zinc-Coated (Galvanized) Reinforcing Bars: Zinc-coated (galvanized) reinforcing bars shall conform to ASTM A767. Supplementary requirements S1 and S2 shall apply when fabrication after galvanization includes cutting and bending. Supplementary requirement S2 shall apply when fabrication after galvanization includes only bending. Repair of damaged zinc coating when required shall be made with a zinc-rich formulation conforming to ASTM A767. Repair shall be done in accordance with the material manufacturer's recommendations.

2) Epoxy-Coated Reinforcing Bars: Epoxy-coated reinforcing bars shall conform to ASTM A775. Coating damaged due to shipping, handling and placing need not be repaired in cases where the damaged area is 0.1 square inches or smaller. Repair damaged areas larger than 0.1 square inches with patching material conforming to ASTM A775 and in accordance with the material manufacturer's recommendations. The maximum amount of damage including repaired and unrepaired areas shall not exceed 2 percent of the surface area of each bar. Fading of the coating color will not be cause for rejection of epoxy-coated reinforcement.

3. Bar Mats:

a. Furnish and install bar mats for structural concrete Work where shown and/or noted on the Contract Drawings.

b. Bar mats shall be of the clipped type conforming to ASTM A184 and shall be fabricated from reinforcing bars that conform to the requirements of this Section.

1) Bar mats shall be fabricated from zinc-coated (galvanized) reinforcing bars. Metal clips shall be zinc-coated (galvanized). Non-metallic clips may be used. Coating damage at the clipped intersections shall be repaired in accordance with the requirements of this Section.

2) Bar mats shall be fabricated from epoxy-coated reinforcing bars. Metal clips shall be epoxy-coated. Non-metallic clips may be used. Coating damage at the clipped intersections

shall be repaired in accordance with the requirements of this Section.

4. Wire:

   a. Wire shall be smooth or deformed wire as indicated in the Contract Documents.

      1) Smooth wire shall conform to ASTM A82.

      2) Deformed wire shall conform to ASTM A496, size D4 and larger.

5. Welded Wire Fabric:

   a. Welded wire fabric shall be fabricated from smooth or deformed wire and shall conform to the wire size and wire spacing required or indicated on the Contract Documents. Welded wire fabric shall conform to one of the following specifications:

      1) Plain wire fabric ASTM 1064, except welded intersections shall be spaced not farther apart than 12 inches in the direction of the principal reinforcement.

      2) Deformed wire fabric ASTM A497, except welded intersections shall be spaced not farther apart than 16 inches in the direction of the principal reinforcement.

6. Spirals:

   a. As indicated in the Contract Documents, spirals shall be fabricated from reinforcing bars or wire.

B. Wire Bar Supports

1. Unless noted otherwise on the Contract Drawings, wire bar supports shall be in accordance with Class 1, maximum protection or Class 2, moderate protection in Chapter 3 of CRSI DA4.

C. Coated Wire Reinforcement Supports

1. Epoxy-Coated Reinforcement:

   a. Use wire reinforcement supports coated with dielectric material including epoxy or other polymer for a minimum distance of 2 inches from the point of contact with epoxy-coated reinforcement.

2. Zinc-Coated Reinforcement:

   a. Use galvanized wire reinforcements supports or wire reinforcement supports coated with dielectric material with zinc-coated reinforcement.

D. Precast Concrete Reinforcement Supports

1. Concrete supports used for supporting reinforcement shall be not less than 4 inches square having a compressive strength equal to or greater than the specified compressive strength of the concrete being placed.

E. Dowel Adhesive System

1. Where shown on the Contract Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

2. The embedment depth of the bar shall be per manufacturer's recommendations, so as to provide a minimum allowable bond strength that is equal to 125 percent of the yield strength of the bar, unless noted otherwise on the Contract Drawings.

3. The adhesive system shall be as specified in this Section:

4. The Engineer's approval is required for use of this system in locations other than those shown on the Contract Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Welding

1. When required or permitted, all welding of reinforcing bars shall conform to ANSI/AWS D1.4. Unless otherwise permitted by the Engineer, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.

2. Welding of wire to wire, and of wire or welded wire fabric to reinforcing bars or structural steels, shall conform to applicable provisions of ANSI/AWS D1.4 and any supplementary requirements specified by the Supervising Engineer for Concrete Construction for the particular application.

3. After completion of welding on zinc-coated (galvanized) or epoxy-coated reinforcing bars, coating damage shall be repaired in accordance with the requirements of this Section. All welds and all steel splice members when used to splice bars shall be coated with the same material used for repair of coating damage.

B. Fabrication

1. All reinforcement shall be bent cold unless otherwise permitted by the Engineer.

2. Fabricating and Placing Tolerances:

3. Reinforcing bars shall be fabricated in accordance with the standard fabricating tolerances in Figures 4 and 5 of ACI 315. Tolerances shall not permit a reduction in cover.

4. Placing Tolerances for Reinforcement:

Item	Tolerances, Inches
1. Clear distance:	
a. To formed soffit	-1/4
b. To other formed surfaces	±1/4
2. Minimum spacing between bars:	-1/4
3. Clear distance from unformed surface to top reinforcement:	
a. Members 8 inches deep or less	±1/4
b. Members more than 8 inches deep but less than 24 inches deep	-1/4, +1/2
c. Members 24 inches deep or greater	1/4, +1
4. Uniform spacing of bars, but the required number of bars shall not be reduced:	±2
5. Uniform spacing of stirrups and ties, but the number of stirrups and ties shall not be reduced:	±1
6. Longitudinal locations of bends◦ and ends of reinforcement:	
a. General	±2
b. Discontinuous ends of members	±1/2
7. Length of bar laps:	1-1/2
8. Embedded length:	
a. For bar sizes No. 3 through 11	-1
b. For bar sizes No. 14 and 18	-2

5. When it is necessary to move bars to avoid interference with other reinforcement, conduits or embedded items exceeding the specified placing tolerances, the resulting arrangement of bars shall be subject to approval of the Engineer.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Testing

1. The Contractor shall provide samples from each load of reinforcing steel delivered in a quantity as directed by the Engineer for testing.

2. In addition,, the Contractor shall provide samples of each type of welded splice used in the work in a quantity and of dimensions as directed by the Engineer for testing. At the discretion of the Engineer, radiographic testing of direct butt-welded splices will be performed. The Contractor shall provide assistance necessary to facilitate testing. The Contractor shall repair any weld which fails to meet the requirements of AWS D1.4.

3. The testing will be performed by QA/QC consultant employed and paid by the City to ensure that reinforcing steel and welded splice comply with the technical requirements of the Contract.

4. The Contractor shall be charged by the City for the cost of any additional tests and investigation on work performed which does not meet the specifications.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Placing

1. Minimum concrete cover for reinforcement, except for extremely corrosive atmosphere, other severe exposures or fire protection shall be as follows unless indicated otherwise on the Contract Documents.

2. Minimum Concrete Cover for Reinforcement:

Item	Minimum Cover, Inches
1. Slabs and Joists:	
a. Top and bottom bars for dry conditions:	
1) No. 11 bars and smaller	1
2) No. 14 and No. 18 bars	1-1/2
b. Bars in formed concrete surfaces exposed to water or weather, and over or in contact with sewage and for bottoms bearing on work mat, or slabs supporting earth cover:	
1) No. 5 bars and smaller	1-1/2
2) No. 6 through No. 18 bars	2
2. Beams and Columns:	
a. For dry conditions:	
1) Stirrups, spirals and ties	1-1/2
2) Principal reinforcement	2
b. Exposed to earth, water, sewage or weather:	2
1) Stirrups and ties	2-1/2
2) Principal reinforcement	
3. Walls:	
a. For dry conditions:	
1) No. 11 bars and smaller	1
2) No. 14 and No. 18 bars	1-1/2
b. Formed concrete surfaces exposed to earth, water, sewage, weather or in contact with ground	2

Item	Minimum Cover, Inches
4. Footings and Base Slabs:	
a. At formed sides and ends and bottoms bearing on concrete work mat	2
b. At unformed surfaces and bottoms in contact with earth	3
c. Top of footings	Same as slabs
d. Over top of piles	2

3. For bundled bars, minimum concrete cover shall be equal to the equivalent diameter of the bundles but need not be greater than 2 inches; except for concrete deposited against and permanently in contact with ground, minimum cover shall be 3 inches. The equivalent diameter of the bundle shall be based on a single bar of a diameter derived from the equivalent total area.

4. Unless otherwise indicated on the Contract Documents, reinforcement supported from the ground or mud mat shall rest on precast concrete blocks not less than 4 inches square and having a compressive strength equal to or greater than the specific compressive strength of the concrete being placed. Other means of support may be used if accepted by the Engineer.

5. Reinforcement supported from formwork shall rest on bar supports made of concrete, metal, plastic or other acceptable materials. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all bar supports within 1/2 inch of the concrete surface shall be non-corrosive or protected against corrosion.

6. Zinc-coated (galvanized) reinforcing bars supported from formwork shall rest on galvanized wire bar supports coated with dielectric material or on bar supports made of dielectric material or other acceptable materials. All other reinforcement and embedded steel items in contact with galvanized reinforcing bars or within a minimum clear distance of 2 inches from galvanized reinforcing bars unless otherwise required or permitted shall be galvanized.

7. Epoxy-coated reinforcing bars supported from formwork shall rest on coated wire bar supports or on bar supports made of dielectric material or other acceptable materials. Wire bar supports shall be coated with dielectric material for a minimum distance of 2 inches from the point of contact with

the epoxy-coated reinforcing bars. Reinforcing bars used as support bars shall be epoxy coated. In walls having epoxy-coated reinforcing bars, spreader bars, where specified, shall be epoxy coated. Proprietary combination bar clips and spreaders used in wall with epoxy-coated reinforcing bars shall be made of corrosion-resistant material or coated with dielectric material.

8. Zinc-coated (galvanized) reinforcing bars shall be fastened with zinc-coated tie wire or non-metallic-coated tie wire or other acceptable materials.

9. Epoxy-coated reinforcing bars shall be fastened with nylon-epoxy or plastic-coated tie wire; or other acceptable materials.

10. Welded wire fabric for slabs on grade shall extend to within 2 inches of the concrete edge. Welded wire fabric may extend through the contraction joints. Welded wire fabric shall be adequately supported during placing of concrete to assure proper positioning in the slab.

11. Bending or straightening of bars partially embedded in concrete shall not be permitted except when specifically approved by the Engineer. Bending and preheating shall be in accordance with the requirements of this Section.

B. Bending of Bars

1. Minimum Inside Bend Diameters:

a. The minimum inside bend diameters shall conform to the following requirements unless otherwise permitted by the Engineer.

Bar Size	Minimum Diameter
No. 3 through 8	6 bar diameters
No. 9, 10, 11	8 bar diameters
No. 14 and 18	10 bar diameters

2. The beginning of the bend shall not be closer to the concrete surface than the minimum diameter of bend. Preheating, if required, shall be in accordance with the requirements of the Section. The following requirements shall be adhered to for individual bar sizes:

Bar Size	Bend Requirements
No. 3 through No. 5	Bars may be cold bent the first time. Cold bend bars only when temperature is above 32 degrees Fahrenheit.

Bar Size	Bend Requirements
	Preheating is required for subsequent straightening or bending.
No. 6 and larger	Preheating is required.

3. When zinc-coated (galvanized) or epoxy-coated reinforcing bars are field bent, coating damage shall be repaired in accordance with the applicable requirements of the Section.

C. Preheating of Bars

1. Preheating prior to bending or straightening, when required, shall be in accordance with the following requirements:

   a. The preheat shall be applied to a length of bar equal to at least 5 bar diameters each way from the center of the bend except that preheat shall not extend below the surface of the concrete. The temperature of the bar at the concrete interface shall not exceed 500 degrees Fahrenheit.

   b. The preheat temperature shall be 1100 to 1200 degrees Fahrenheit.

   c. The preheat temperature shall be maintained until bending or straightening is complete.

   d. The preheat temperature shall be measured by temperature measurement crayons, contact pyrometer or other acceptable method.

   e. Heated bars shall not be artificially cooled until the material temperature is less than 600 degrees Fahrenheit.

2. Preheating may be applied by any method which does not harm the bar material or cause damage to the concrete.

D. Splicing

1. Reinforcing bar splices shall only be used at locations shown on the Contract Drawings. When it is necessary to splice reinforcing at points other than where shown, the character of the splice shall be approved by the Engineer.

2. The length of lap for reinforcing bars, unless otherwise shown on the Contract Drawings shall be in accordance with ACI 318 for a class B splice.

3. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each

2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

4. Mechanical and welded splices shall be used only where shown on the Contract Drawings or when approved by the Engineer.

5. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Contract Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

E. Dowel Adhesive System Installation

1. The installation of the dowels shall be done in strict conformance with the manufacturer's recommendations. The dowels shall be supported in the correct position until the adhesive sets and gains enough strength to prevent any dislocation.

2. At least 25 percent of the dowels to be installed shall be proof tested to 1.33 times the allowable load specified by the manufacturer of the adhesive-injection system.

3. If the dowels are required to have a hook at the end to be embedded in the new work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate the testing.

F. Miscellaneous Installation Requirements

1. Exposed Reinforcement:

a. Reinforcement left exposed for the bonding of future construction shall be effectively protected from corrosion by encasement in cement mortar or by other temporary covering as approved by the Engineer.

2. Field Cutting of Reinforcement:

a. Reinforcement shall not be cut in the field except when specifically permitted by the Engineer in writing.

3. Reinforcement Through Expansion Joint:

a. Reinforcement or other embedded metal items bonded to the concrete shall not be continuous through any joint intended as an expansion joint. Dowels bonded on only one side of a joint and waterstops may extend through the joint.

3.03 FIELD TESTING / QUALITY CONTROL

A. Inspection

1. No concrete shall be deposited until the Supervising Engineer for Concrete Construction or his approved representative has inspected the placing of the reinforcing steel and has given permission to place the concrete. Concrete placed in violation of this provision may be rejected with subsequent removal by the Contractor.

2. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.

3. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 03 30 00 – CAST- IN-PLACE CONCRETE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Work specified in this Section consists of providing all labor, materials, equipment, supervising, testing and incidentals necessary to furnish and install cast-in-place concrete as indicated on the Contract Drawings and as specified herein.

B. Work includes producing concrete consisting of Portland cement, fine and coarse aggregate, water and approved admixtures; proportioned, mixed, transported, placed, finished and cured as specified. Work shall also include:

1. Providing openings in concrete as required to accommodate Work under this and other Sections.

2. Building into the concrete all items such as sleeves, frames, anchor bolts and inserts required to accommodate the Work.

C. This Section covers cast-in-place structural concrete for use in buildings and structures and miscellaneous cast-in-place concrete.

D. This Section covers the requirements of Executive Order 23 for low carbon concrete and clean construction practices.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	7
1.06	Quality Assurance	9
1.07	Submittals	12
1.08	Delivery, Storage, and Handling	16
1.09	Spare Parts, Special Tools, and Supplies	17
1.10	Warranty	17
PART 2	PRODUCTS	17
2.01	Manufacturers	17
2.02	Materials / Equipment	20
2.03	Fabrication / Assembling / Finishes	28
2.04	Source Quality Control / Shop Tests	32
PART 3	EXECUTION	34

3.01 Examination / Preparation 34
3.02 Implementation 35
3.03 Field Testing / Quality Control 60
3.04 Startup / Demonstration 77
3.05 Adjusting / Protection / Cleanup.....77

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 03 10 00 - Concrete Forming and Accessories

C. Section 03 21 00 - Reinforcing Steel

D. Section 03 32 00 - Joints in Concrete

E. Section 03 35 00 - Concrete Finishing

F. Section 03 60 00 - Grouting

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M 182 Specification for Burlap Cloth Made From Jute or Kenaf and Cotton Mats

2. AASHTO TP 23 Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying

3. AASHTO T 318 Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying

B. American Concrete Institute (ACI):

1. ACI CT-18 ACI Concrete Terminology

2. ACI 117 Specification for Tolerances for Concrete Construction and Materials and Commentary

3. ACI 207.1R Guide to Mass Concrete

4. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

5.	ACI 213R	Guide for Structural Lightweight-Aggregate Concrete
6.	ACI 214R	Guide to Evaluation of Strength Test Results of Concrete
7.	ACI 301	Specifications for Concrete Construction
8.	ACI 302.1R	Guide to Concrete Floor and Slab Construction
9.	ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
10.	ACI 305R	Guide to Hot Weather Concreting
11.	ACI 306R	Guide to Cold Weather Concreting
12.	ACI 308.1	Specification for Curing Concrete
13.	ACI 309R	Guide for Consolidation of Concrete
14.	ACI 311.4R	Guide for Concrete Inspection
15.	ACI 318	Building Code Requirements for Structural Concrete and Commentary on Building Code Requirements for Structural Concrete
16.	ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
17.	ACI 347R	Guide to Formwork for Concrete
18.	ACI 506R	Guide to Shotcrete
19.	ACI 506.2	Specification for Shotcrete
20.	ACI MNL-2	ACI Manual of Concrete Inspection
21.	ACI MNL-15	Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with selected ACI references.

C. American National Standards Institute/National Science Foundation (ANSI/NSF) Standard 61 - “Drinking Water System Components - Health Effect”

D. American Society for Testing and Materials (ASTM)

22.	ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
23.	ASTM C 33	Standard Specification for Concrete Aggregates
24.	ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

25.	ASTM C40	Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
26.	ASTM C 42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
27.	ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
28.	ASTM C 94	Standard Specification for Ready-Mixed Concrete
29.	ASTM C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
30.	ASTM C 138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
31.	ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
32.	ASTM C 150	Standard Specification for Portland Cement
33.	ASTM C 157	Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete
34.	ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
35.	ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
36.	ASTM C 173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
37.	ASTM C 227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations
38.	ASTM C 231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
39.	ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
40.	ASTM C 295	Standard Guide for Petrographic Examination of Aggregates for Concrete
41.	ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

42.	ASTM C 311	Test Method for Sampling & Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
43.	ASTM C 330	Standard Specification for Lightweight Aggregates for Structural Concrete
44.	ASTM C 387	Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete and High Strength Mortar
45.	ASTM C 470	Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
46.	ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
47.	ASTM C 567	Standard Test Method for Density Structural Lightweight Concrete
48.	ASTM C 595	Standard Specification for Blended Hydraulic Cements
49.	ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
50.	ASTM C845	Standard Specification for Expansive Hydraulic Cement
51.	ASTM C 881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
52.	ASTM C 882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
53.	ASTM C 979	Standard Specification for Pigments for Integrally Colored Concrete
54.	ASTM C 989	Standard Specification for Slag Cement for Use in Concrete and Mortars
55.	ASTM C 1064	Standard Test Method for Temperature of Freshly Hydraulic-Cement Concrete
56.	ASTM C 1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
57.	ASTM C 1141	Specification for Admixtures for Shotcrete

58.	ASTM C 1157	Standard Performance Specification for Hydraulic Cement
59.	ASTM C 1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
60.	ASTM C 1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
61.	ASTM C1293	Standard Test Method for Determination of Length Change of Concrete due to Alkali-Silica Reaction
62.	ASTM C 1398	Test Method for Laboratory Determination of time of Setting of Hydraulic-Cement Mortars Containing Additives for Shotcrete by the Use of Gillmore Needles
63.	ASTM C 1480	Packaged, Pre-Blended, Dry, Combined Materials for Use in Wet or Dry Shotcrete Application
64.	ASTM C 1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
65.	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
66.	ASTM C1778	Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
67.	ASTM E 329	Standard Specification for Agencies Engaged in the Construction Inspection Testing of Special Inspection

E. The Building Code of the City of New York (NYCBC)

F. Concrete Plant Manufacturer's Bureau (CPMB) - "Concrete Plant Standards."

G. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI – "Manual of Standard Practice"
2. CRSI – "Placing Reinforcing Bars"

H. National Ready Mixed Concrete Association (NRMCA)

I. New York State Department of Transportation (NYS DOT) - Standard Specifications

J. Portland Cement Association (PCA) – "The Design and Control of Concrete Mixtures"

K. Definitions

1. Inspection Requirements – Special Inspections requirements of the New York City Building Code as defined in NYCBC 1704.4 shall apply to all applicable materials and construction.

2. Lightweight Concrete - Concrete intentionally made to have low density by use of lightweight aggregate and usually required to have an air-dry unit weight less than one hundred and fifteen (115) pounds per cubic foot.

3. Normal Weight Concrete - Concrete for which density is not a controlling attribute, made with aggregates of types covered by ASTM C 33, and usually having unit weights in the range of one hundred and thirty five (135) to one hundred and sixty (160) pounds per cubic foot.

4. Supervising Engineer for Concrete Construction - Professional Engineer designated by the Commissioner, who will be responsible for coordination of Special Inspections and Buildings Form TR1: Technical Report Statement of Responsibility. The Supervising Engineer for Concrete Construction may or may not be the Resident Engineer. The Supervising Engineer for Concrete Construction shall undertake all responsibilities outlined in Article 28 and NYCBC 1704.4 Special Inspections of the New York Building Code.

5. Other technical words and terms used in this Section are defined in ACI CT-18.

6. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

7. Global Warming Potential (GWP) - Measure of how much a specific greenhouse gas contributes to global warming compared to carbon dioxide (CO2) over a given time period, usually one hundred (100) years.

1.05 DESCRIPTION

A. Classes of Concrete:

1. Class 25 - use for lean concrete.

a. Class of concrete as recommended by NYCDOT specification for sidewalks, headers and curb.

2. Class 40LW - use for structural Lightweight Concrete

3. Class 45 - use for all concrete unless indicated otherwise.

   a. Class 45 concrete with a corrosion inhibitor and crystalline waterproofing in the mix design.

4. Class 45F - use as an alternate to Class 45 for:

   a. Foundations

   b. Walls greater than or equal to 18inches in thickness

5. Class 45PG – use for non-structural applications.

6. Class 45M - use for mass concrete.

7. Class 45HES- use for High Early Strength concrete, minimum 4,500 psi at 7 days with corrosion inhibitor and crystalline waterproofing.

8. Class 50 - use for precast concrete with corrosion inhibitor and crystalline waterproofing in the mix design. This mix shall be used for all precast concrete, unless indicated on the Contract Documents.

B. Work in Connection with other disciplines:

1. All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting. No concrete shall be deposited until the Resident Engineer or his authorized representative has inspected the placement of the embedded items and the reinforcing bars and has given his permission to place the concrete.

2. All Work related to the concrete or must be supported by it, shall be coordinated with the Work of this Section, including but not limited to the introduction or furnishing of embedded items prior to concrete placement.

3. Electrical conduits, junction boxes or pipes shall be placed prior to concreting. The Contractor shall coordinate the placement of such items of Work in order that they are installed in accordance with all requirements of the New York City Building Code. The Contractor shall protect such installations to the extent that they are not displaced or damaged during concrete placement.

4. Openings in slabs shall be provided for pipes, conduits and the like required for the Work of others where indicated on the Contract Drawings or for which directions are given prior to placing concrete. When Work of others is completed, the excess part of the respective

openings shall be completely closed up to the pipe sleeve and/or inserts to match the adjoining Work.

5. Sleeves for miscellaneous metalwork, castings, pipes and anchors furnished shall be set true and to proper alignment in the concrete as indicated on the Contract Drawings or required by the manufacturer's templates.

6. Voids in embedments shall be filled temporarily with readily removable material to prevent entry of concrete into the void.

1.06 QUALITY ASSURANCE

A. General:

1. Work performed under this Section shall comply with the applicable provisions and recommendations in Article 1.04 - References of this Section.

2. The Contractor shall employ, at its own expense, a testing laboratory experienced in the design and testing of concrete materials and mixes. This laboratory shall be responsible for all concrete mix design and trial batch testing.

a. Unless otherwise approved, all mix designs shall be run in the presence of DEP designated personnel.

3. Testing agencies that perform testing services on concrete shall meet the requirements of ASTM E 329 and be licensed by the New York City Department of Buildings.

4. Testing laboratory shall have been inspected within the last two (2) years by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology for testing concrete aggregates and for the preparation and testing of concrete trial batches with or without admixtures. The laboratory shall provide documentation indicating how any deficiencies in the latest CCRL inspection report have been corrected.

5. Testing and inspection shall be conducted in accordance with the requirements of ASTM C 1077 and other applicable standards.

6. Prior to performing any Work, the qualifications of the proposed testing agency shall be submitted for review and acceptance by the DEP.

7. Tests of concrete required by this Section shall be made by an ACI Concrete Field Testing Technician Grade 1 or equivalent. Equivalent certification programs shall include requirements for written and performance examinations as stipulated in ACI publication CP1.

8. Prior to approval, all testing of proposed materials and mix designs including trial batch and shrinkage testing shall be at the Contractor's expense.

9. Concrete materials and operations will be tested and inspected by the Supervising Engineer for Concrete Construction or his authorized representative as the work progresses. Failure to detect defective Work or material shall not in any way prevent later rejection when a defect is discovered nor shall it obligate the Engineer for final acceptance.

10. Materials and installed Work may require testing and retesting, as directed by Engineer, at any time during the progress of the Work. Contractor shall allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at Owner's expense, including the retesting of rejected materials and installed Work, shall be done at Contractor's expense.

B. Laboratory Trial Batch:

1. Each concrete mix specified shall be verified by a laboratory trial batch, unless indicated otherwise. Each trial batch shall also be witnessed by a DEP representative.

2. Each trial batch shall be reported on DEP's Mix Design Submittal (MDS) forms and shall include the following testing:

   a. Aggregate gradation for fine and coarse aggregates.

   b. Combined aggregate gradation including total percentage of each aggregate size retained on each sieve.

   c. Fly ash testing to verify meeting specified properties, unless certification by an independent testing laboratory is provided by the fly ash supplier.

   d. Slump.

   e. Air content.

   f. Compressive strength based on 3 cylinders tested at 7 days and 3 cylinders tested at 28 days (6 cylinders minimum.)

   g. Shrinkage test, as specified herein, for Class 45 concrete except Class 45M.

3. Each trial batch shall provide the following information:

   a. Project identification name and number.

      1) Specified strength f'c.

      2) Name of the concrete producer supplying materials.

3) Name of the Design Trial Lab.

b. Date of trial.

c. Complete identification of aggregate source of supply.

d. Tests of aggregates for compliance with specified requirements.

e. Scale weight of each aggregate.

f. Absorbed water in each aggregate.

g. Brand, type and composition of cement.

h. Brand, type and amount of each admixture.

i. Amounts of water used in trial mixes.

j. Proportions of each material per cubic yard.

k. Gross weight and yield per cubic yard of trial mixtures.

l. Measured slump.

m. Measured air content.

n. Shrinkage test results where required and as specified herein.

o. A minimum of three (3) trial runs with different water/cement ratios shall be performed for each mix design proposed.

p. Compressive strength developed at seven (7) days and twenty eight (28) days, and if required, fifty six (56) days or longer. A minimum of three (3) test cylinders shall be cast for each 7-day, 28-day and/or 56-day test for each trial run.

4. The requirement for a trial batch may be waived if the required test information has been provided in a previous laboratory trial batch run on the identical mix design within the previous twelve (12) months and the history of the concrete mix field results are acceptable to the Supervising Engineer for Construction. The same brand, type, source and supplier of all materials must have been used.

5. On the day of the trial test, the laboratory shall provide to DEP witness a 1-2 lb. neat cement sample for delivery to DEP Laboratory for chemical composition analysis, for fly ash and slag and cement.

C. Shrinkage Test:

1. Drying shrinkage tests, as specified herein, shall be performed with every trial batch test.

2. Drying shrinkage specimens shall be four (4) inch by four (4) inch by eleven (11) inch prisms with an effective gage length of ten (10) inches,

fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: Specimens shall be removed from molds at an age of 23 ±1 hours after trial batching, shall be placed immediately in water at seventy (70) degrees F ±3 degrees F for at least thirty (30) minutes, and shall be measured within thirty (30) minutes thereafter to determine original length and then submerged in saturated lime water at seventy three (73) degrees F ±3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age seven (7) days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F ±3 degrees F and 50 percent ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after initial seven (7) days of moist curing.

3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 2, herein.

1.07 SUBMITTALS

A. General:

1. The Contractor shall submit to the Engineer, in accordance with Section 01 33 00 – Submittal Procedures for all concrete mix designs and cement grout mix designs produced by a ready-mix plant.

2. A new mix design shall be submitted to the Engineer for approval. Prior to changing the brand, type, size or source of cementitious materials, aggregates, water, ice or admixtures, new historical field strength test data, data from new trial mixtures or evidence which indicates that the change will not adversely affect the relevant properties of the concrete shall be submitted. Proposed mix proportions and all related data, in a format acceptable to the Engineer, shall be submitted to the Engineer

for review six (6) weeks before the start of any concreting operations. The complete mix design shall include all components of concrete, including admixtures. Mix designs shall be prepared, signed and sealed by a Professional Engineer licensed in the State of New York.

3. Materials, equipment and aggregates approved by the Materials Bureau of the New York State Department of Transportation (NYSDOT), in the most recent NYSDOT approved lists mentioned below, are acceptable for use without a detailed submission. Submittal is required stating the particular material, equipment or aggregate source to be used with approval identification number, and/or page number.

    a. Materials and Equipment NYSDOT Approved Materials List

    b. Approved List Sources of Fine and Coarse Aggregates

B. Certifications:

1. All materials used in the manufacture of concrete shall be accompanied by a certificate from the manufacturer or fabricator or supplier indicating test results of current production stockpiles or shipments.

2. Submit notarized certification of conformance to referenced standards when requested by Engineer.

3. All mix designs shall be accompanied by an Environmental Product Declaration (EPD) in compliance with Article 2.03.

    a. If an EPD is not available prior to January 1, 2025, submit the negative proof and Global Warming Potential (GWP) calculations for each mix design in accordance with Article 2.05.

C. Delivery Tickets:

1. The Contractor shall submit to the Engineer a copy of the delivery ticket for each load of concrete delivered to the Site. Delivery tickets shall contain all information specified in ASTM C94 Section 14.1.

2. Provide batch tickets for each batch of job-site mixed concrete as specified.

D. Submit samples of materials as specified and as otherwise may be requested by the Engineer, including names, sources, and descriptions.

E. Shop Drawings:

1. Manufacturer’s specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.

2. All information pertinent to a concrete plant to be erected at the site as required by the CPMB Publication "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau."
3. Detailed description of conveying equipment.
4. Detailed description of concrete placement methods.
5. Proposed procedures for bonding new concrete work to existing including manufacturer's information on proposed bonding agents.
6. Proposed normal procedures for protection and curing of concrete including manufacturer's literature for proposed curing compounds.
7. Proposed special procedures for protection of concrete under wet weather placement conditions.
8. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
9. Proposed method for underwater placement.
10. Proposed method of measuring concrete surface temperature changes.
11. Detailed procedures and materials for repair of defective concrete.
12. Detailed procedures for removing stains, rust, efflorescence, and surface deposits.
13. Materials and procedures to be used to plug tie holes, other than for Portland cement mortar.
14. Proposed methods to measure concrete compressive strength by means other than field cured cylinders for termination of curing, such as maturity, penetration resistance, pulse velocity, rebound hammer, or pullout strength. All non-destructive test methods for compressive strength are considered estimations which require correlation to actual known strengths established through cores or cylinder test results for reliability.
15. The following information, if ready-mixed concrete is used.
    a. Identification of Ready-Mixed Concrete Supplier including the plant location and all pertinent information required by the CPMB Publication "Concrete Plant Standards of the Plant Manufacturers Bureau."
    b. Locations of sources of materials for cement, fine and coarse aggregates, and water, and the brands and types of admixtures to be used.
    c. Physical capacity of mixing plant.

d. Trucking facilities available.

e. Estimated average amount which can be produced and delivered to the site during a normal 8-hour day, excluding the output to other customers.

16. Requests and Notifications:

a. Request to use the volumetric batching method.

b. Request for acceptance of preplacement activities: This request is to ensure that the pre-placement activities are complete and have been properly inspected. The Contractor shall sign-off on a Concrete Placement Card indicating that the Work is complete and is ready for placement. A sample of the required Concrete Placement Card is attached at the end of this Section. The Supervising Engineer for Concrete Construction will sign-off on the items to be inspected but this does not relieve the Contractor from coordinating the concrete placement properly and meeting all requirements of the Contract. The Contractor shall submit the completed Concrete Placement Card to the Supervising Engineer for Concrete Construction in accordance with Article 3.01, Paragraph B - Preparation for Concrete of this Section, and with sufficient time to obtain receipt of authorization from DEP to place concrete in conformance with the latest DEP concrete placing guidelines.

c. Advance notification of forthcoming placement including arrangements to coordinate tests and inspection.

d. Requests to exceed the ASTM C 94 required time of discharge.

F. Test and Inspection Reports:

1. Information on types, classes, procedures, names and plant locations for cementitious materials; types, pit or quarry locations, producers' names, gradations and properties required by ASTM C 33 for aggregates; types, brand names, producers' names for admixtures; and source of supply for water and ice.

2. Except for admixtures and water, test results not more than ninety (90) days old confirming the conformance of all concrete materials with applicable specifications.

3. Testing agencies shall submit the results of all tests and inspections performed during the course of the work to the Supervising Engineer for Concrete Construction. Reports from the Testing Agency shall be on forms acceptable to the Supervising Engineer for Concrete Inspection.

4. Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests Review of required submittals shall be by the Project Design Engineer for acceptance unless specifically noted otherwise. Production of concrete to comply with the specified requirements is the responsibility of the Contractor.

5. A complete record of the date and details of each concrete placement including the exact location thereof and the date of removal of forms. This record shall be coordinated with and in addition to that maintained by the Supervising Engineer for concrete inspection.

6. Mixture Proportions:

   a. Mixture proportions conforming to the requirements of the New York City Administrative Building Code and this Section for water/cement ratio, cement content, slump, maximum size of coarse aggregate, air content, admixtures, and chloride concentration, as well as compressive strength.

   b. Method and test data used to establish proportions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Cement shall be stored in weather tight buildings, bins or silos which will provide protection from dampness and contamination and will minimize warehouse set.

B. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation or contamination with other materials or with any other sizes of like aggregates. To ensure that this condition is met, any test for determining conformance to requirements for cleanliness and grading shall be performed on samples secured from the aggregates at the point of batching. Frozen or partially frozen particles shall not be used.

C. Stockpiles of natural sand shall be allowed to drain freely to minimize variations in moisture content throughout the stockpile.

D. Admixtures shall be stored in such a manner as to avoid contamination, evaporation or damage. For those used in the form of suspensions or non-stable solutions, suitable agitating equipment shall be provided to assure uniform distribution of the ingredients. Liquid admixtures shall be protected from freezing and other temperature changes which would adversely affect their characteristics. All admixture containers shall be clearly marked with paint as to their content and dosage.

E. Lightweight Aggregates:

1. Cover or presoak coarse and fine lightweight aggregates when transporting them.

2. Presoak dry lightweight aggregates unless presoaking is not recommended by the aggregate supplier or is not acceptable to the Engineer. Leave presoaked aggregates in the stockpile after soaking for at least twelve (12) hours before using.

3. Do not allow machinery to run over lightweight aggregates.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cementitious Materials

1. Silica fume shall be one of the following:

a. MasterLife SF100 as manufactured by Master Builders Solutions, Beachwood, OH;

b. Force 10,000 D as manufactured by GCP Applied Technologies, Cambridge, MA.;

c. Sikacrete 950 DP as manufactured by Sika Corp., Lyndhurst, NJ;

d. Eucon MSA as manufactured by the Euclid Chemical Company, Cleveland, OH;

e. Or approved equal.

B. Concrete Admixtures:

1. Shrinkage reducing admixtures shall be one of the following:

a. Eclipse as manufactured by GCP Applied Technologies, Cambridge, MA;

b. MasterLife SRA 035 and MasterLife CRA 007, as manufactured by Master Builders Solutions, Beachwood, OH;

c. Or approved equal.

2. Corrosion inhibiting admixture shall be one of the following:

a. DCI or DCI-S, as manufactured by GCP Applied Technologies, Cambridge, MA;

b. MasterLife CI 30 as manufactured by Master Builders Solutions, Beachwood, OH;

c. Eucon CIA, as manufactured by Euclid Chemical Company, Cleveland, OH;

d. Or approved equal.

3. Crystalline waterproofing shall be one of the following:

a. ADMIX as manufactured by Penetron International, East Setauket, NY;

b. Sika WT-215P as manufactured by Sika Corp., Lyndhurst, NJ;

c. MasterLife 300 C or 300D or 300L as manufactured by Master Builders Solutions, MBCC Group, Beachwood, OH;

d. Krystol Internal Membrane (KIM) as manufactured by Kryton, Vancouver, British Columbia, Canada;

e. Xypex C-Series as manufactured by Xypex, Richmond, British Columbia, Canada;

f. Or approved equal.

C. Concrete bonding agent

1. Two component epoxy-resin bonding agent shall be one of the following:

a. Sikadur 32, Hi Mod LPL, as manufactured Sika Corp., Lyndhurst, NJ;

b. Dural LPL MV as manufactured by the Euclid Chemical Company, Cleveland, OH;

c. Pro-Poxy 200 as manufactured by Dayton-Superior, Miamisburg, OH;

d. FX-752 as manufactured by Simpson Strong-Tie, Pleasanton, CA;

e. Or approved equal.

2. Three component epoxy modified cementitious bonding agent shall be one of the following:

a. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.

b. Or approved equal.

D. Finishing Aids:

1. Evaporation retardant shall be one of the following:

a. MasterKure ER 50, as manufactured by Master Builders Solutions, Beachwood, OH;

b. Eucobar, as manufactured by Euclid Chemical Company, Cleveland, OH;

c. SikaFilm, as manufactured by Sika Corp., Lyndhurst, NJ;

d. Or approved equal.

E. Curing and Protection Materials:

1. Curing compounds shall be one of the following:

a. Super Aqua Cure VOX, as manufactured by Euclid Chemical Company, Cleveland, OH;

b. Sealtight 1100, as manufactured by W.R. Meadows, Inc., Hampshire, IL;

c. MasterKure, as manufactured by Master Builders Solutions, Shakopee, MN;

d. Or approved equal.

2. Temperature Monitoring Equipment:

a. IQT-Meter or IQM-Meter as manufactured by James Instruments Inc., Chicago, IL;

b. Or approved equal.

F. Crack Injection Materials:

1. Epoxy:

a. Epoxies for injection shall be one of the following:

1) Sikadur 35, Hi Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corp., Lyndhurst, NJ;

2) Dural Injection Gel, as manufactured by Euclid Chemical Company, Cleveland, OH;

3) Or approved equal.

2. Hydrophilic Resin:

a. Hydrophilic resins shall be one of the following:

1) Sika Inject 215, as manufactured by Sika Corp., Lyndhurst, NJ;

2) Or approved equal.

G. Concrete Repair Materials:

1. Concrete repair mortar shall be one of the following:

a. Five Star Structural Concrete, as manufactured by Five Star Products, Inc., Shelton, CT;

b. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, as manufactured by Sika Corp., Lyndhurst, NJ;

c. MasterEmaco S 488CI or S 466-CI, as manufactured by Master Builders Solutions, Shakopee, MN;

d. Verticoat or Verticoat Supreme, as manufactured by the Euclid Chemical Company, Cleveland, OH;

e. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. All materials used in concrete or the curing and repair of concrete, which can contact potable water, shall be certified as meeting the requirements of ANSI/NSF 61 for contact with potable water when in the finished concrete.

B. Materials listed in this Section apply to all concrete unless specified otherwise in the Contract.

C. Cementitious Materials

1. Cement:

a. Portland cement, ASTM C 150, Type II; or blended hydraulic cement, ASTM C595 Type IP (MS). Cement type used shall be appropriate for site exposures.

1) NYCBC 1904.4

b. Portland cement shall be produced by an acceptable, recognized manufacturer. The cement shall be produced by one plant only per mix design. Alternate cement sources may be used provided that a mix design has been accepted and a trial batch verifying performance has been made.

c. Cement which has deteriorated because of improper storage or handling shall be rejected.

2. Fly Ash and Natural Pozzolans:

a. Fly ash mineral admixture, when used, shall meet the requirements of ASTM C 618 Class F, except as follows:

1) The loss on ignition shall be a maximum of 4%.

2) The maximum percent of sulfur trioxide (SO_3) shall be 4.0.

b. Natural pozzolan mineral admixture, when used, shall meet the requirements of ASTM C 618 Class N.

c. Fly ash and natural pozzolans used in concrete that contacts potable water shall be certified as meeting the requirements of ANSI/NSF 61.

3. Slag Cement:

a. Slag cement mineral admixture, when used, shall meet the requirements of ASTM C 989, Grade 100 or better.

b. Slag cement will be permitted as a substitute for fly ash or natural pozzolans, at no additional cost to DEP, in the event that Class F Fly Ash or Class N natural pozzolans are not available. The slag cement substitution shall be in the same proportions and percentages of the total cementitious material as indicated for Fly Ash. A higher percentage of slag cement of the total cementitious material in concrete shall be permitted as approved by the Engineer to suit the project needs.

c. Laboratory trial batches will be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

d. Slag cement used in concrete that contacts potable water shall be certified as meeting the requirements of ANSI/NSF 61.

4. Silica Fume:

a. Silica fume mineral admixture shall be the dry compacted or slurry form and shall meet the requirements of ASTM C 1240. Silica Fume shall be considered to be a cementitious material. Application rate shall be 7 percent by weight of cement, unless indicated otherwise.

D. Aggregate

1. Coarse and fine aggregates shall meet the requirements of ASTM C 33 with the requirements of Table 3, Class 4S. Soundness shall be tested using magnesium sulfate. Abrasion resistance shall be tested using the

Los Angeles Abrasion Test. For testing requirements, concrete shall be assumed to be subject to abrasion.

2. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces. Marine dredged aggregates shall not be used.

3. The loading, storing, unloading, and batching of aggregates shall be done in such a manner as to prevent segregation, intermingling, or the inclusion of foreign materials. All aggregates shall remain in free drainage storage until a stable moisture content is attained prior to placement in the batching plant bins. Each size of coarse aggregate and the fine aggregate shall be kept in separate hoppers or bins. All aggregates shall be delivered to the batching plant bins by a belt conveyor or other approved means; and the operation thereof shall be controlled so as to prevent the mixing of the sizes and kinds of aggregates with each other. Any mixture of fine and coarse aggregates or of the two sizes of coarse aggregate in the batching plant bins or prior thereto shall be cause for rejection of such materials, and the affected bin or bins shall be emptied and inspected prior to refilling with the correctly graded aggregate.

4. Fine Aggregates:

   a. Fine aggregate shall be composed of clean, sharp, hard, strong, durable, insoluble, uncoated, natural sand free from loam, clay lumps or other deleterious substances.

   b. Dune sand, bank run sand and manufactured sand are not acceptable.

   c. Sand having FM less than 2.40 or greater than 3.00 shall not be allowed.

   d. Fine aggregate shall meet the requirements of ASTM C 33 except that loss when tested for soundness using magnesium sulfate shall not exceed twelve (12) percent.

5. Coarse Aggregates:

   a. Coarse aggregate shall be crushed stone processed from natural rock or stone and shall consist of clean, hard, strong, durable, insoluble, unweathered, and uncoated pieces of uniform quality throughout; and shall be free from such alkali, decomposed minerals, organic material, clay, mica, schist, or other foreign matter that will render it unsuitable.

   b. Use of slag and pit or bank run gravel is not permitted.

c. Coarse aggregate gradations shall be as specified in Table 1 - Concrete Mix Requirements and shall meet the requirements of ASTM C 33. All aggregate gradations listed for each concrete class shall be used.

d. Coarse aggregate shall meet the requirements of ASTM C 33, Table 3, Class 4S, with the following additional requirements.

1) Clay lumps shall not exceed one (1.0) percent by weight of coarse aggregate.

2) Shale and other soft particles shall not exceed 3.0 percent by weight of coarse aggregate.

3) Thin, elongated, or laminated particles shall not exceed three (3.0) percent by weight of coarse aggregate.

4) Loss when tested for soundness using magnesium sulfate shall not exceed twelve (12.0) percent.

e. Coarse aggregate for Lightweight Concrete shall conform to ASTM C 330 and shall meet the gradation requirements for ¾" to No. 4.

f. Nominal maximum size of coarse aggregate shall be not larger than:

1) 1/5 the narrowest dimension between sides of forms, nor

2) 1/3 the depth of slabs, nor

3) 3/4 the maximum clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, bundled tendons or ducts.

g. The requirements of Article 2.02, Paragraph D.5.f, shall not apply if, in the judgment of the Engineer, workability and methods of construction are such that concrete can be placed without honeycombs or voids.

6. Combined Aggregate:

a. Aggregate gradations shall be determined during trial batch testing and shall be based upon the combined gradation and particle distribution in the mixture of coarse and fine aggregates.

b. Fine aggregate and coarse aggregate sizes specified shall be combined to produce a workable and cohesive concrete mix that is appropriate for its specific application. Coarse aggregate contents shall be based on Table 6.3.3 of ACI 211.1. Adjust the

content required for pumping applications as specified in ACI 211.1.

c. The total quantity of fine aggregate shall be not more than forty-five (45) percent nor less than 32.5 percent by weight of the total aggregate for Normal Weight Concrete. Using a total quantity of fine aggregate which does not meet this specified range shall only be acceptable when approved by the Engineer. The total quantity of fine aggregate shall be not more than forty-five (45) percent nor less than 32.5 percent by weight of the total aggregate for Normal Weight Concrete. Using a total quantity of fine aggregate which does not meet this specified range shall only be acceptable when approved by the Engineer

d. Gradations of combined aggregate shall be plotted and submitted on:

1) A combined grading chart (percent passing versus sieve size).

2) An aggregate Particle Distribution Chart (percent retained versus sieve size).

7. Fine and coarse lightweight aggregates for Lightweight Concrete shall conform to ASTM C 330. Between twenty (20) to thirty-five (35) percent shall pass the No. 50 sieve and between ten (10) to twenty (20) percent shall pass the No. 100 sieve in the sand fraction gradation. Normal weight aggregate for Lightweight Concrete shall conform to ASTM C 33.

E. Concrete Admixtures

1. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer’s printed instructions. All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Do not use admixtures which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by Engineer.

2. Air entraining admixtures shall conform to the NYS DOT Materials Bureau approved list and ASTM C 260.

3. Normal range or midrange water reducing admixture shall be in conformance with ASTM C 494 Type A, and comply with the NYS DOT Materials Bureau approved list.

4. High-Range Water Reducing Admixture:

a. High range water reducer shall conform to ASTM C 494, Type F or G and comply with the NYS DOT Materials Bureau approved list.

b. The high range water-reducing admixture shall be accurately measured and added at the batch plant facility. The Contractor may redose the concrete no more than two (2) times with the high range water reducer at the site, provided that a calibrated dispenser system and containers of high range water reducer sealed and labeled by the manufacturer are used.

5. Set Controlling Admixture:

a. Set controlling admixture shall be either with or without water-reducing properties.

b. Where the air temperature at the time of placement is expected to be consistently over 90 degrees Fahrenheit, a water-reducing set controlled admixture conforming to ASTM C 494, Type D and the NYS DOT Materials Bureau approved list.

c. Where the air temperature at the time of placement is expected to be consistently under 40 degrees Fahrenheit, except for mass concrete placement, a non-corrosive, non-chloride accelerator conforming to ASTM C 494, Type C and the NYS DOT Materials Bureau approved list shall be used.

6. Shrinkage Reducing Admixture:

a. A shrinkage-reducing admixture is permitted to be used in the mix design where necessary to meet specified shrinkage limitations provided that specified strength requirements are met and there is no reduction in sulfate resistance and no increase in permeability.

7. Corrosion Inhibiting Admixture:

a. Corrosion inhibiting admixture shall be a calcium nitrite solution containing a minimum of thirty (30) percent calcium nitrite.

b. The quantity of mix water shall be adjusted to account for the water portion of the calcium nitrite solution.

c. As the calcium nitrite solution accelerates setting time, retarding admixtures shall be provided as needed, unless the admixture has been formulated to not accelerate setting.

8. Calcium chloride, admixtures containing thiocyanate, or admixtures containing more than 0.05 percent chloride ions shall not be used.

9. Crystalline Waterproofing, added crystalline based permeability reducing admixture. Crystalline waterproofing admixture use appropriate manufacturer's product for specific contract work.

F. Water

1. Water for concrete, mortar, and grout shall be clean and free from objectionable mineral salts and from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. Water shall meet the requirements of ASTM C 94.

G. Bonding Agent

1. Provide a two-component epoxy-resin bonding agent conforming to ASTM C 881.

2. Provide three-component epoxy modified cementitious bonding agent where two component bonding agent does not provide sufficient open time.

H. Finishing Aids

1. Evaporation Retardant:

a. Evaporation retardant shall be a material which seals the surface of plastic concrete to prevent moisture loss. The material shall be able to be worked into the concrete surface by subsequent finishing operations with no adverse effect on finishing effort and no discoloration of the finished concrete.

I. Curing and Protection Materials

1. Absorptive covers shall consist of burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.

2. Curing mats shall be heavy carpets or cotton mats, quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

3. Moisture retaining covers shall conform to ASTM C 171 and consist of one of the following materials.

a. Waterproof paper.

b. Polyethylene film.

c. White burlap-polyethylene sheet.

4. Curing compounds shall conform to the requirements of ASTM C 309 Type 1-D (water retention requirements):

a. Provide fugitive dye when requested by Engineer.

5. Insulation Blankets:

   a. Closed cell flexible foam sheet material such as polystyrene or urethane. Foam sheet material which is capable of being bent ninety (90) degrees without breaking or tearing shall be provided at corners. The foam insulation blankets shall be 1/2-inch thick.

   b. Quilted, flexible insulation blankets that retain their insulating value when wet and which retard the evaporation of water.

6. Temperature Monitoring Equipment:

   a. Thermocouples or thermistors shall be as manufactured by James Instruments Inc. or equal. They shall be suitable for embedment in concrete and capable of registering temperatures within the accuracy of 0.5 degrees Fahrenheit over a minimum temperature range of twenty (20) to two hundred (200) degrees Fahrenheit.

   b. Temperature monitoring and recording equipment shall consist of rechargeable battery-powered recording thermometers with microprocessors. The equipment shall be capable of taking and recording temperature readings at each temperature sensor at preset time intervals. The thermometer units shall be compatible with the temperature sensors used, shall have a non-volatile memory capacity of at least one hundred and twenty (120) readings per sensor, and shall be designed to be connected to a battery-powered compatible printer unit. Time periods shall be able to be set over a minimum range of ten (10) to sixty (60) minutes. The thermometer unit shall be designed and constructed for construction conditions. Sufficient thermometer units shall be provided to take readings from all temperature sensors plus one (1) additional backup unit for every ten (10) units in service. One (1) printer unit shall be provided for every twenty (20) thermometer units with sufficient paper supply to record all readings taken.

J. Crack Injection Materials

1. Epoxy:

   a. Epoxy for injection shall be a low viscosity, high modulus moisture insensitive type.

2. Hydrophilic Resin:

   a. Hydrophilic resin shall be an acrylic-ester based resin with a maximum viscosity of 50 cps. It shall cure into a flexible rubber-like material which has the potential for unrestrained increase in

volume in excess of one hundred (100) percent in the presence of water.

K. Concrete Repair Materials

1. Concrete repair mortar shall be a prepackaged polymer-modified cementitious repair mortar with the following minimum properties:

   a. Compressive strength at one day: 2000 psi (ASTM C 109).

   b. Compressive strength at 28 days: 6000 psi (ASTM C 109).

   c. Bond strength at 28 days: 1800 psi (ASTM C 882 modified).

2. Cement mortar shall consist of a mix of 1 part cement to 1 1/2 parts sand with sufficient water to form a trowelable consistency. Minimum compressive strength at twenty-eight (28) days shall be 4000 psi. Where required to match the color of adjacent concrete surfaces, white portland cement shall be blended with standard portland cement so that, when dry, the patching mortar shall match the color of the surrounding concrete.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Proportioning and Mixing

1. Prepare concrete design mixes subject to the limitations listed in Table 1 and specified herein so as to create a homogeneous mix and a concrete which meets the specified strength requirements and, of equal importance, provides a concrete which is water tight and durable against deterioration and abrasion. The mix design shall produce a concrete of a consistency which can be placed so as to meet the required finished appearance. The minimum cement necessary to produce the required strength shall be used. This Section applies to concrete mixes using ½ inch and larger nominal maximum aggregate. For mixes using smaller aggregate sizes, see Section 03 60 00 - Grouting. The mix design shall be submitted using the Mix Design Submittal Form at the end of this Section.

2. Air Content:

   a. All concrete shall be air entrained unless indicated otherwise.

   b. Air content for Normal Weight Concrete shall be as follows:

Nominal Maximum Aggregate Size (in.)	**Total Air Content, percent by Volume (+/- 1.5%)**

1/2	7
3/4	6
1	6
1-1/2	5.5

3. Lightweight Concrete shall contain six (6) percent ± two (2) percent total air when the nominal maximum size of coarse aggregate is greater than 3/8 in., or seven (7) percent ± two (2) percent when the nominal maximum size is 3/8 in. or less as determined in accordance with ASTM C173.

4. Slump:

   a. Slump for all concrete shall be three (3) +/- one (1) inches, unless indicated otherwise.

   b. Where high range water reducing admixture is used, the specified water-cementitious material ratio shall be reduced by 0.02 and concrete shall be proportioned for no higher than 3-inch slump. The slump after addition of the high range water reducing admixture shall not exceed eight (8) inches when measured at the point of placement.

   c. A tolerance of up to two (2) inches above the maximum indicated slump shall be allowed for one (1) batch in any five (5) consecutive batches tested provided that it can be demonstrated that the specified water-cementitious material ratio is not exceeded.

   d. The slump of Lightweight Concrete for floors shall not exceed four (4) inches at the point of placement.

   e. For troweled floors, the slump of structural Lightweight Concrete with one hundred (100) percent normal weight sand discharged by pump shall not exceed four (4) inches at the point of placement.

5. Shrinkage Limitation:

   a. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at twenty-one (21)-day drying age or at twenty-eight (28)-day drying age shall be 0.039 percent or 0.045 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations shall

not apply to Class 25 and 40LW concrete, unless indicated otherwise.

b. If the trial batch results fail to meet the shrinkage limitation, the mix shall be redesigned to reduce shrinkage. Alternately, the Contractor may use a higher shrinkage mix when acceptable to the Engineer, provided that the amount of shrinkage reinforcement in the structures is increased as determined by the Engineer to resist the higher levels of shrinkage stresses. The additional reinforcing shall be provided at the Contractor's expense.

6. The percentage of mortar in the concrete mix shall not exceed sixty (60) percent for Class 50, 45 and 45F concrete. Exceeding this specified mortar percentage shall only be acceptable when approved by the Engineer.

7. The unit weight limitations for Lightweight Concrete shall be as shown on the Contract Drawings.

8. Proportioning: Concrete proportions shall be determined in accordance with the provisions of Sections 1905.2.1 through 1905.2.3 of the NYCBC.

a. Proportions of materials for concrete shall be established to provide

1) The proportioning of ingredients shall produce a mixture that will provide workability and consistency to permit concrete to be worked readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the Work, but without permitting the materials to segregate or excessive bleeding. Yield of all mixes as designed shall not exceed 27.2 cu.ft./cu.yd.

2) Resistance to special exposures are required by NYCBC Section 1904.

3) Conformance with the strength test requirements of Sections 1905.6

b. Concrete is to meet the durability requirements of Section 1904 of NYCBC.

c. Where different materials are to be used for different portions of proposed Work, each combination shall be evaluated.

d. Concrete proportions shall be established in accordance with NYCBC Section 1905.3 or Section 1905.4, and shall comply with the applicable requirements of Section 1904.

1) NYCBC Section 1905.3 - Proportioning on the basis of field experience/or trial mixtures. Concrete proportioning determined on the basis of field experience or trial mixtures shall be done in accordance with ACI 318, Section 5.3. If the required f'_c is obtained for trial batch mixed prior to the date specified, the trial mix design may be approved. All mixes shall be approved by the Engineer prior to construction.

2) NYCBC Section 1905.4 - Proportioning without field experience. Concrete proportioning determined without field experience or trial mixtures shall be done in accordance with ACI 318, Section 5.4. This method of proportioning shall not be permitted for load-carrying structural concrete or concrete mix proportions that are required to conform to NYCBC Section 1904.

e. Proportioning on the basis of field experience and/or trial mixtures using a mix design employing the same ingredients proposed for use, and used successfully on a previous project, or projects, may be used provided the following are submitted by a licensed concrete testing laboratory and approved by the Design Engineer of record in conformance with NYCBC 1905.3 and ACI 318 Section 5.3.

1) The name and location of the plant from which the concrete will be batched.

2) The concrete mix design including detailed data and analysis of the ingredients proposed for use as specified herein.

3) Reports for at least 30 (thirty) consecutive tests of seven (7) day and twenty-eight (28) day concrete strength tests of the proposed mix made during the previous twelve months of concrete batched and delivered from the same plant that is to furnish this job. These data shall include an evaluation in accordance with ACI 214R to determine the average strengths, moving averages and the coefficients of variation. In addition, the results of a minimum of three (3) shrinkage tests for this mix made

during the previous twelve months and using the same materials to be used on this project.

4) Reports of compliance tests of fine and coarse aggregates made during the above tests.

f. Average strength reduction. As data becomes available during construction, it is permissible to reduce the amount by which the average compressive strength (f'_c) is required to exceed the specified value of f'_c in accordance with ACI 318, Section 5.5.

g. Evaluation and acceptance of concrete. The criteria for evaluation and acceptance of concrete shall be as specified in NYCBC Sections 1905.6.3.3 through 1905.6.5.5.

h. Qualified technicians. Concrete frequency and testing shall be tested in accordance with the requirements of NYCBC Section 1905.6.2 thru 1905.6.5.5. An agency shall performs tests on fresh concrete at the job site, prepare specimens required for curing under field conditions, prepare specimens required for testing in the laboratory and record the temperature of the fresh concrete when preparing specimens for strength tests. All field sampling and testing, including the testing of aggregates, concrete mixes, and strength testing of specimens, shall be subject to special inspection by an approved agency. All testing laboratories shall be approved testing agencies and shall employ qualified special inspectors to perform all required laboratory tests. Test results from the testing laboratory shall be promptly distributed by the Contractor to the concrete producer and the Engineer.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

2.05 Sustainability Performance Requirements

A. The Global Warming Potential (GWP) limits for all concrete mixes are identified in Table 1.

1. Specific targets for Global Warming Potential (GWP) are provided in Table 1. It shall be permitted to propose innovative products and manufacturing processes for approval by the Engineer of Record. Proposed alternatives shall meet all performance criteria for strength, durability, and constructability, and achieve the required reduction in carbon footprint.

B. Submit an EPD for ready-mix concrete, for approval by the Engineer.

1. If an EPD for a concrete mix is available, the value given for the GWP of a mix will be the A1- A3 GWP listed on the EPD.
   a. Effective January 1, 2025, ready-mix concrete supplied to the construction site shall be delivered with a product-specific EPD. Failure to submit an EPD will exclude the mix from being used.
   b. EPDs shall be submitted using the project Web-Based Project Management Information System in accordance with Section 01 31 25 - Web-Based Project Management Information System. EPDs shall be submitted together with the relevant material submittal for approval by the Engineer.
2. If an EPD for ready-mix concrete is not available, prior to January 1, 2025:
   a. Submit negative proof evidence that no product, plant or mix-specific EPD could be sourced, for approval by the Engineer.
   b. Calculate the GWP of the ready-mix concrete using the Greenhouse Gas (GHG) Emission Coefficients and the GWP formula shown in the table and equation below.

Material	GHG Emission Coefficient (lb./lb.)
Portland cement (PC)	1.04823
Portland Limestone cement (PLC)	0.95100
Portland Slag cement (1S)	0.73439
Calcium Sulfoaluminate (CSA)	0.73360
Fly Ash (FA)	0.32847
Carbonated Fly Ash (CFA)	0.27900
Granulated Blast Furnace Slag (GBFS)	0.26363
Ground Glass Pozzolan (GGP)	0.05560
Crushed Coarse Aggregate (CA)	0.00372
Fine Aggregate and Gravel (SG)	0.00258
Recycled Aggregate (RCA)	0.00120
Lightweight Aggregate (LWA)	0.30000

$$GWP = (1.04823 * mPC) + (0.95100 * mPLC) + (0.73439 * m1S) + (0.73360 * mCSA) + (0.32847 * mFA) + (0.27900 * mCFA)$$

+ (0.26363 * mGBFS) + (0.05560 * mGGP) + (0.00372 * mCA)
+ (0.00258 * mSG) + (0.00120 * mRCA) + (0.30000 *mLWA)

Where:
GWP is the A1 Global Warming Potential in pounds per cubic yard.
m is the mass of each constituent in the concrete mix in pounds.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection

1. The Contractor and its installer shall examine the substrate and the conditions under which Work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Preparation for Concrete

1. All reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork shall be inspected and approved by the Supervising Engineer for Concrete Construction prior to concrete placement. Contractor shall provide written notice of intention to place concrete a minimum of one (1) working day prior to placement.

2. The Contractor shall provide the following preparation before placing of concrete.

   a. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.

   b. Formwork shall have been completed in conformance with Section 03 10 00 - Concrete Forming and Accessories; ice and standing water shall have been removed; reinforcement shall have been secured in place in conformance with Section 03 21 00 - Reinforcing Steel; expansion joint material, anchors and other embedded items shall have been positioned. Concrete shall not be placed on frozen ground.

   c. Subgrade shall be watered sufficiently to achieve surface saturated density of subgrade materials.

d. Soft spots in subgrade shall be removed and replaced with approved backfill materials.

e. No concrete shall be placed until the entire preparation has been approved by the Supervising Engineer for Concrete Construction or his authorized representative.

f. When high ambient temperatures necessitate protection of concrete immediately after placing or finishing, make provisions in advance of concrete placement for windbreaks, shading, fogging, sprinkling, ponding, or wet covering with a light-colored material.

g. During cold weather, make provisions in advance of concrete placement to maintain the temperature of the concrete above fifty-five (55) degrees Fahrenheit. Use heating, covering or other means adequate to maintain the required temperature without injury to concrete due to concentration of heat. Do not use combustion heaters during the first twenty-four (24) hours unless precautions are taken to prevent exposure of the concrete to exhaust gases containing carbon dioxide.

3.02 IMPLEMENTATION

A. Mixing and Transporting Concrete

1. General:

a. The Contractor shall provide the production of concrete which includes batching, mixing, delivering, and discharging of concrete according to the following requirements.

2. Ready-Mixed Concrete:

a. Ready-Mixed concrete shall be batched, mixed and transported in accordance with the appropriate sections of “Specifications for Ready-Mixed Concrete” (ASTM C 94 or ASTM C685). Follow the detailed recommendations given in Guide for Measuring, Mixing, Transporting, and Placing Concrete (ACI 304R), where applicable.

b. Each truck mixer or agitator shall have attached thereto in a prominent place a metal plate issued by the Truck Mixer’s Manufacturer’s Bureau by the manufacturer complying with Section 11.1.2 of ASTM C 94 for that truck mixer and the limitations thereon shall be strictly adhered to.

c. Ready-mixed concrete shall only be batched in plants which meet the following:

1) Concrete plants shall be certified by the National Ready Mixed Concrete Association (NRMCA) and shall comply with the rules of the department.

2) Upon written application by the producer, accompanied by a detailed report on how the facilities compare with the standards of the NRMCA, the above requirements may be waived, in writing by the Engineer.

3) If the detailed report mentioned above is issued by the testing agency which will perform the inspection of the batching and mixing of the concrete and indicates that satisfactory quality concrete can be produced by the plant in question, based on prior job performance records, then the above requirement will be waived, in writing, by the Supervising Engineer for Concrete Construction.

d. Approval of plants as outlined above is subject to the continuous checking and acceptance by the Commissioner or his duly authorized representative.

e. Only plants meeting the requirements for certification of the NRMCA for automatic batching and automatic recording will be permitted.

1) If at any time automatic proportioning or recording instruments become inoperative, the plant may be allowed to batch concrete manually or operate with manual recording for a period of not more than 48 working hours from the time of breakdown.

2) If at the end of 48 working hours, the plant is still not in operating order, the following shall be complied with:

a) DEP shall be contacted and an independent inspector, other than the regular plant inspector shall be assigned to each batching operation at the plant, at no additional cost to DEP.

b) Additional inspectors shall observe and record the weight of each component of the batch.

c) The manually recorded batch weights shall appear on a ticket presented to inspection personnel at the project site.

f. Concrete producers shall have their plants inspected quarterly by NYSDOT.

g. Concrete producers shall have their scales and trucks certified quarterly by NYSDOT.

3. Batch Mixing at Site:

a. The concrete shall be produced in a plant conforming to the requirements of the "Concrete Plant Standards" of the Concrete Plant Manufacturer's Bureau and ACI 318, Section 5.8.3. Prior to erection of such plant at the site, the Contractor shall submit to the Supervising Engineer for Concrete Construction, for approval, all pertinent data relative to the plant.

b. All components of the plant must bear the proper rating plates issued by the Concrete Plant Manufacturers Bureau and the limitations thereon shall be strictly adhered to.

c. On job site plants for jobs requiring less than one thousand (1000) cubic yards of structural concrete or a job site plant that would operate for less than thirty (30) working days duration, the requirements of Article 3.02 Paragraph A.2.e. for automatic batching and automatic recording will be waived. If at any time automatic proportioning devices or recording instruments become inoperative, follow the provisions of Article 3.02, Paragraphs A.2.e.1 and A.2.e.2.

d. The batch shall be so charged into mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first twenty-five (25) percent of the specified mixing time. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. When concrete of normal weight is specified, controls shall be provided to ensure that no additional water may be added during mixing. The entire batch shall be discharged before the mixer is recharged.

e. Each batch of two (2) cubic yards or less shall be mixed for not less than 1 1/2 minutes. The mixing time shall be increased to fifteen (15) seconds for each additional cubic yard or fraction thereof. Shorter mixing time may be permitted provided performance tests made in accordance with ASTM C 94 indicate that the time is sufficient to produce uniform concrete. At least three (3) quarters of the required mixing time shall take place after the last of the mixing water has been added. The interior of the mixer shall be free of accumulations that will interfere with

mixing action. Replace mixer blades when they have lost ten (10) percent of their original weight.

f. When small quantities of concrete are produced on the Site, measure solid materials by weight, and liquid or paste materials by weight or by volume. Mix all materials in a mechanical mixer. If packaged dry combined materials are used, they shall conform to the requirements of ASTM C 387, and shall be capable of satisfying the requirements of this Specification Section.

4. Control of Admixtures:

a. Air entraining and chemical admixtures shall be charged into the mixture as a solution and shall be dispensed by an automatic dispenser or similar measuring device. The accuracy of measurement of any admixture shall be within ± three (3) percent. Admixtures shall be charged into the mixer in such manner as not to come into direct contact with the cement.

b. Two (2) or more admixtures may be used in the same concrete provided such admixtures are added separately during the batching sequence and provided further that evidence is submitted to show that the admixtures used in that combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

c. All admixtures shall be added prior to mixing.

5. Structural Lightweight Concrete:

a. This section covers the requirements for production of structural Lightweight Concrete and appurtenances in structures. Portions of the structure to be treated as Lightweight Concrete under the provisions of this Section are so designated on the Contract Drawings. Lightweight Concrete shall comply with all requirements of this Section unless otherwise specified in the Contract.

b. Performance and Design Requirements:

1) Entrain air in Lightweight Concrete that will be exposed to freezing and thawing conditions. Use six (6) ± two (2) percent total air content when the nominal maximum size of aggregate is greater than 3/8 in. Use seven (7) ± two (2) percent total air content when the nominal maximum size is 3/8 or less. Determine the air content by the volumetric methods of ASTM C 173. Select

concrete mixture proportions for concrete to provide a compressive strength as required by the Contract Drawings.

2) Use ASTM C 150 Type II or Type V cement for Lightweight Concrete required to be chemical-resistant. Select concrete mixture proportions to provide a specified minimum compressive strength 4000 psi, unless otherwise specified on the Contract Drawings.

c. Mixtures:

1) Proportion Lightweight Concrete mixtures to meet the specified limit on maximum air-dry unit weight as determined by the method of ASTM C 567. Correlate the air-dry unit weight with the fresh unit weight of the same concrete to permit use of the latter as the basis for acceptance during construction.

2) Determine the cement factor needed to attain the required strength for Lightweight Concrete in accordance with the N.Y. City Administrative Building Code and relate strength to cement content of the concrete.

d. Batching and Mixing:

1) Batch and mix lightweight aggregate concrete as recommended by the aggregate producer and the concrete producer, and in accordance with this Section. If the procedure recommended by the aggregate producer and the concrete producer is at variance with this Section, submit the producers' recommendations to the Engineer for acceptance.

2) For low absorption aggregate, batch and mix aggregate that has been shown to absorb less than two (2) percent water by weight during the first hour after inundation. Test aggregate for water absorption with the minimum moisture content likely to occur on the job. Pre-dampening may be used to achieve this condition.

3) For high absorption aggregate, batch and mix concrete made with lightweight aggregates absorbing two (2) percent water by weight or more by:

a) First, add the aggregate to approximate eighty (80) percent of the mixing water and mix for a

minimum of 1 1/2 minutes in a stationary mixer or fifteen (15) revolutions at mixing speed in a truck mixer.

b) Then add any admixtures, the cement, and the withheld portion of mixing water and complete the mixing.

4) Additional water may be added to the mixture, if needed, to bring the mixture to the specified slump after truck transport. Increase the slump of concrete entering the pump as required to maintain the specified slump at the point of placement.

5) The lightweight aggregate shall be presoaked by vacuuming, ponding, or sprinkling continuously with water until the aggregate moisture content is sufficient to minimize slump loss through the pump line. Slump loss through the pump line shall not exceed four (4) inches. The presoaking period shall be up to thirty (30) days or as required by the Engineer after determination at the batch plant.

6. Tempering and Control of Mixing Water:

a. Concrete shall be mixed only at the mix plants or at the job Site. Concrete shall be mixed in quantities not to exceed immediate job placement requirements.

b. The addition of any water to the mix while the truck is en route from plant to job site is strictly prohibited. Mixing in transit is strictly prohibited. Agitating in transit is permitted, but shall be kept to a minimum.

c. When concrete arrives at the point of delivery with a slump below that which will result in the specified slump at the point of placement and is unsuitable for placing at that slump, the slump may be adjusted to the specified value by adding water if all the water required in the accepted mixture proportions has not been added at the start of mixing and if permitted by the Engineer. Addition of water shall be in accordance with ASTM C 94. Neither the specified water-cement ratio nor slump shall be exceeded. Do not make slump adjustments after 15 percent of the batch has been unloaded. Do not add water to concrete containing a plasticizing or a high range water reducing admixture. Do not add water to concrete in delivery equipment not acceptable for mixing. Measure air content of air-entrained

concrete, after slump adjustment, to verify compliance to specified requirements.

d. Each increment of water added at the job site must be incorporated by additional mixing by turning the drum not less than thirty (30) revolutions. The addition of the increments of water and the start of the mixing procedures shall not be commenced earlier than one-half hour prior to the beginning of discharge. From the time the batch or load has been mixed to the specified slump, no further water shall be added to the concrete.

e. Discharge of the concrete shall be completed within the limits set out in the following table. Time and drum revolution limits shall be measured from the introduction of any mixing water to the cement and aggregates or the introduction of the cement to the aggregates (ribbon loading).

CONCRETE DISCHARGE REQUIREMENTS	
Concrete Temperature	**Limit**
Over 90 degrees F	Concrete shall be removed from site and discarded
85° to 90 degrees F	1 hour or 300 revolutions, whichever comes first
80° to 85 degrees F	1 hour 15 minutes or 300 revolutions, whichever comes first
70° to 80 degrees F	1 hour 30 minutes or 300 revolutions, whichever comes first
Below 70 degrees F	2 hours or 300 revolutions, whichever comes first

7. Weather Conditions:

a. Cold Weather:

1) To maintain the temperature of the concrete above the minimum placing temperature required by Article 3.02, Paragraph B.4.c, the as-mixed temperature shall not be less than 55 degrees F when the mean temperature falls below 40 degrees F. Follow the detailed recommendations given in “Cold Weather Concreting” (ACI 306R), where applicable.

2) If water or aggregate has been heated above 100 degrees F, the water shall be combined with the aggregate in the

mixer before cement is added. Cement shall not be added to mixtures of water and aggregate when the temperature of the mixture is greater than ninety (90) degrees Fahrenheit.

b. Hot Weather:

1) The ingredients shall be cooled before mixing if necessary to maintain the temperature of the concrete below the maximum placing temperature required by Article 3.02, Paragraph B.4.c. The temperature of the concrete at initial discharge shall not exceed eighty-five (85) degrees F. Follow the detailed recommendations given in "Hot Weather Concreting" (ACI 305R), where applicable.

c. Under special circumstances, and with written approval of the Supervising Engineer for Concrete Construction, the above provisions as to the initial discharge temperature of the concrete may be modified.

d. Accelerators or retarders may be used with the approval of the Supervising Engineer for Concrete Construction. When permitted, they shall be used in accordance with "Hot Weather Concreting" (ACI 305R).

8. Mixing Small Quantities of Concrete:

a. Only when permitted by the Supervising Engineer for Concrete Construction, small quantities of concrete may be mixed either by a small manually controlled portable mixer or by hand. In such cases, volumetric measurement of aggregates will be permitted.

b. Concrete shall be hand mixed on a watertight platform. Cement and aggregates shall first be mixed dry until a uniform color is obtained. Water shall then be added and the entire mass turned over at least six times, or until the mixture is uniform and of the required consistency. Not more than one-half (1/2) cubic yard of concrete shall be hand mixed in any batch.

B. Concrete Placement

1. General:

a. The Contractor shall provide concrete placement including preparation before placing, conveying, depositing, consolidation, weather protection, bonding, underwater

concreting, and placing of grout and mortar according to the following requirements.

2. Conveying:

   a. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients and in a manner which will assure that the required quality of the concrete is obtained. Follow the detailed recommendations given in ACI 304R, where applicable.

   b. Conveying equipment shall be of size and design to ensure a continuous flow of concrete at the delivery end and shall be approved. Conveying equipment and operations shall conform to the following requirements:

      1) Conveying equipment shall contain no aluminum components.

      2) Truck mixers, agitators, and non-agitating units and their manner of operation shall conform to the applicable requirements of Article 3.02.A.

      3) Belt conveyors shall be horizontal or at a slope which will not cause segregation or loss. Protect concrete to minimize drying and effects of temperature rise. Use an acceptable discharge hopper at the discharge end to prevent segregation. Do not allow mortar to adhere to the return length of the belt.

      4) Chutes shall be metal or metal-lined having rounded bottoms and shall have a slope not exceeding one (1) vertical to two (2) horizontal and not less than one (1) vertical to three (3) horizontal. Chutes more than twenty (20) feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

      5) Pump equipment shall be of suitable kind and adequate pumping capacity and shall be subject to approval by the Supervising Engineer for Concrete Construction. Placement shall be controlled so that segregation does not occur in the discharged concrete. Test cylinders for strength and tests for slump, temperature, and air content shall be made on samples of concrete taken at point of discharge from the pump line.

6) The provisions of Article 3.02, Paragraph B.2.b.4 shall apply to placement methods delivering concrete through lines using pneumatic air pressure.

7) The provisions of Article 3.02, Paragraphs B.2.b.4 and B.2.b.5 are not applicable to gunned mortar applications.

3. Depositing:

a. Concrete shall be deposited continuously, or in lifts not to exceed eighteen (18) inches in thickness such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained. Detailed recommendations are given in ACI 304R, where applicable.

b. Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two (2) hours.

c. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to any procedure which will cause segregation.

d. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs.

e. When underwater placement is required or permitted, place concrete by a method acceptable to the Engineer. Deposit the fresh concrete so the concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete.

f. Where a surface mortar is to be the basis of the finish, the coarse aggregate shall be worked back from the forms with a suitable tool so as to bring a full surface of mortar against the form,

without the formation of excessive surface voids. All concrete shall be consolidated by internal vibration, spading, rodding, or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness. Use internal vibrators of the largest size and power that can properly be used in the Work. Over-vibrating and use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at many points, approximately 18 in. apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from five (5) to fifteen (15) second-duration. A spare vibrator shall be kept on the job site during all concrete placing operations. Follow the detailed recommendations given in of ACI 309R, where applicable. Workers shall be experienced in use of the vibrators.

1) External vibration shall only be used when explicitly permitted by the Supervising Engineer for Concrete Construction. Vibrating operations shall be continuous throughout the entire section where concrete is being deposited. Vibrators shall be clamped to the studs or wales or in pairs so that while one is vibrating the other can be shifted to insure constant vibration. External vibration shall conform to the requirements of ACI 309R.

g. Execution:

1) Do not vibrate Lightweight Concrete to the point that large particles of aggregate float to the surface.

2) Do not work Lightweight Concrete to the point that mortar is driven down and an excess of the lightweight aggregate appears at the surface.

h. Self-Supporting Floors and Roofs:

1) Reinforced Concrete Beams and Girders shall be cast monolithically with adjoining arches.

2) Canopies, Cornices and Marquees shall be monolithically cast with floor arches, with profiles true to indicated contours. Top surfaces of canopies and marquees shall be pitched to drain. Exposed soffits and

edges shall be rubbed with carborundum stone and left clean and true.

4. Protection, Weather, Placing and Preparation of Forms:

   a. Concrete placed during rain, sleet or snow, or when the mean daily temperature falls below forty (40) degrees Fahrenheit or is expected to be below forty (40) degrees Fahrenheit during placing or within twenty-four (24) hours thereafter or rises above ninety (90) degrees Fahrenheit shall be adequately protected as provided in Article 3.02, Paragraph C. and approval for placement shall be obtained from the Supervising Engineer for Concrete Construction.

   b. Rainwater shall not be allowed to increase the mixing water nor to damage the surface finish.

   c. Placing temperature:

      1) When the mean daily temperature falls below forty (40) degrees Fahrenheit, the minimum temperature of concrete as placed shall be fifty (50) degrees Fahrenheit. Follow the detailed recommendations given in "Cold Weather Concreting" (ACI 306R), and in accordance with NYCBC Section 1905.12, where applicable.

      2) Concrete deposited in hot weather shall have a placing temperature which will not cause difficulty from loss of slump, flash set, or cold joints. The temperature of the concrete preferably should be less than eighty (80) degrees Fahrenheit and shall not exceed ninety (90) degrees Fahrenheit unless permitted by the Supervising Engineer for Concrete Construction. Loss of slump, flash set, or cold joints due to the temperature of the concrete as placed will not be acceptable. When the temperature of the steel is greater than one hundred and twenty (120) degrees Fahrenheit, fog the steel forms and the reinforcement with water just prior to placing the concrete. Follow the detailed recommendations given in "Hot Weather Concreting" (ACI 305R) and in accordance with NYCBC Section 1905.13, where applicable.

   d. Placing:

1) Adequate skilled personnel and equipment shall be available to handle and place the concrete immediately upon delivery.

2) Dry surfaces shall be wet down before commencing placement of concrete.

3) Temperature of surfaces to receive concrete (earth, forms, reinforcing steel, etc.), should approximate the temperature of the concrete being placed.

4) Evaporation rate of water from freshly placed concrete should be held to a minimum by:

   a) Shading of operations.

   b) Reducing air circulation in area of operations.

   c) Maintaining fog spray during operations.

5) Cold Joints shall be avoided. This can be accomplished by:

   a) Providing adequate skilled personnel to handle and place the concrete immediately after its delivery to the forms at an acceptable temperature.

   b) Placing in layers thin enough and areas small enough so that vibration or working of the concrete will insure complete union of adjacent layers.

   c) Lengthening of setting time by use of approved water reducing retarders.

   d) Placing a bulkhead at a suitable point where placement is stopped temporarily.

6) Loss of slump shall be kept at a minimum. This can be accomplished by:

   a) Minimum lapse of time between mixing and placing.

   b) Avoiding delays in batch mixing and truck dispatching.

   c) Job conditions and equipment (chutes, access runs, etc.) being organized to prevent additional mixing.

d) Use of approved water reducing retarders.

e. Preparation of forms:

1) All forms or surfaces (subgrades, reinforcing steel) to receive concrete, in addition to the normal requirements of tightness, soundness, being free of debris, etc., shall be:

a) Protected against excessive air currents.

b) Sprinkled systematically with cool water.

2) Note: Wetting down around the work will cool the surrounding air and increase the humidity, thus reducing temperatures and evaporation from the concrete.

5. Bonding:

a. When specified, the surface of joints shall be prepared in accordance with Section 03 32 00 - Joints in Concrete.

b. The hardened concrete of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all other not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

c. The hardened concrete of horizontal construction joints in exposed work; horizontal construction joints in the middle of beams, girders or joints, and slabs; and horizontal construction joints in work designed to contain liquids shall be dampened (but not saturated) then thoroughly covered with a coat of neat cement mortar of similar proportions on vertical surfaces and at least one-half (1/2) inch thick on horizontal surfaces. The fresh concrete shall be placed before the mortar has attained its initial set.

d. Joints receiving an adhesive shall have been prepared and adhesive applied in accordance with the manufacturer's recommendations prior to placing of fresh concrete.

e. Surfaces of joints which have been obtained by the use of a chemical retarder shall have been prepared in accordance with the manufacturer's recommendations prior to placing of fresh concrete.

6. Concreting Under Water:

a. Placing concrete in water will be permitted only when approved by the Supervising Engineer for Concrete Construction. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved means, and shall not be disturbed after being deposited. Special care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. Underwater formwork shall be reasonably watertight. The consistency of the concrete shall be carefully regulated and special care shall be exercised to prevent segregation of materials. The method of depositing concrete shall be regulated to produce approximately horizontal surfaces.

b. When a tremie is used, it shall consist of a tube having a diameter of not less than ten (10) inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge end over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the pour has been completed.

c. When a bucket is used to place concrete in water, it shall have a capacity of not less than one-half (1/2) cubic yard.

7. Protection and Cleaning of Exposed Structural Steel:

a. The Contractor shall take all necessary precautions to prevent mortar and concrete splashes on the steel. The Contractor shall exercise care to prevent abrasion or scuffing of the paint on the structural steel while concrete is being formed, placed or stripped.

b. The Contractor shall thoroughly clean the structural steel of all concrete drippings or other foreign matter that may have been deposited on the steel or on any other part of the structure as a result of his operations. All the work involved in thoroughly cleaning the steel shall proceed before concrete drippings have hardened. Immediately after the concrete has been placed, the Contractor shall clean the steel with water and/or such other additional means subject to the approval of the Supervising

Engineer for Concrete Construction as may be necessary to remove all mortar, concrete and other foreign matter that has been dropped, dripped, splashed or otherwise deposited on the steel as a result of his operations. It will be the Contractor's obligation and responsibility to remove all foreign matter to the satisfaction of the Supervising Engineer for Concrete Construction.

c. After formwork has been removed, any concrete or other foreign material that may have been previously missed and that still remains on the steel shall be removed.

8. Concrete finishes shall conform to the requirements of Section 03 35 00 - Concrete Finishing.

C. Concrete Curing and Protection

1. General:

a. Protect all freshly deposited concrete from premature drying, from weather elements, from defacement, from flowing water, and from mechanical injury. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

b. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a seven (7)-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.

c. Concrete curing shall be in accordance with NYCBC Section 1905.11.

2. Curing Methods:

a. The Contractor shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.

1) Ponding or continuous fogging or sprinkling.

2) Application of mats or fabric kept continuously wet.

3) Continuous application of steam (under 150 degrees F).

4) Application of sheet materials conforming to ASTM C 171.

5) If approved by the Engineer, application of a curing compound in accordance with Article 3.02, Paragraph C.7.

6) High Early Strength concrete shall be maintained above 50 degrees F and in a moist condition for at least the first 3 days. Accelerated curing of concrete shall comply with ACI 318, Section 5.11.3.

3. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in Article 3.02, Paragraph C.2.

4. Any of the curing procedures used in Article 3.02, Paragraph C.2 may be replaced by one of the other curing procedures listed in Article 3.02, Paragraph C.2 after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

5. Curing Concrete under Cold Weather Conditions:

   a. Curing under cold weather conditions shall conform to the requirements of ACI 306.

   b. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

   c. The methods of protecting the concrete shall be approved by the Engineer and shall prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

6. Curing Concrete under Hot Weather Conditions:

   a. When air temperatures exceed eighty-five (85) degrees Fahrenheit, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic

shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, in addition to generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

b. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing, consisting of methods listed in Article 3.02, Paragraph C.2.a.1 or C.2.a.2, is mandatory for at least the first 24 hours. Method specified in Article 3.02, Paragraph C.2.a.2. may be used only if the finished surface is not marred or blemished during contact with the coverings.

c. At the end of the initial twenty-four (24)-hour period, curing and protection of the concrete shall continue for at least four (4) additional days using one of the methods listed in Article 3.02, Paragraph C.2.

d. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

7. Use of Curing Compound:

a. Curing compound shall not be used on surfaces to receive subsequent coatings. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

b. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.

c. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed three hundred (300) square feet per gallon. For rough surfaces, apply in two (2) directions at right angles to each other.

8. Early Termination of Curing:

a. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:

1) The strength of the concrete reaches eighty-five (85) percent of the specified twenty-eight (28)-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at fifty (50) degrees Fahrenheit or higher.

2) The strength of concrete reaches the specified twenty-eight (28)-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

3) Tests are made of cylinders kept adjacent to the structure and cured by the same methods and reach seventy (70) percent of the specified compressive strength f'_c as determined in accordance with ASTM C 39.

9. Protection:

a. Floors which have received their final finish shall be closed to all traffic for at least forty-eight (48) hours following the completion of trowelling. Thereafter, before the floor is subjected to any traffic, it shall be covered with paper covering meeting the requirements of ASTM C 171. This protection shall be maintained as long as necessary to avoid damage to the floor.

b. During the curing period, and thereafter as conditions may require, the concrete shall be protected from damaging mechanical disturbances, particularly excessive load stresses, heavy shock, and excess vibration. All finished concrete surfaces shall be protected from damage caused by construction equipment, materials, or methods, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

c. Following removal of protective paper, the surface shall be protected from painting and other work. All stains shall be removed.

D. Mass Concrete

1. Concrete sections four (4) feet or more in the least dimension are termed mass concrete and shall conform to the special provisions of this article in addition to all applicable provisions of other articles in this Section. Mass concrete proportioning, placement, consolidation and curing shall be in accordance with ACI 304R, 309R, 211.1, and 207.1R.

2. Additional requirements for heating, cooling, curing and protecting concrete sections more than 6 feet in the least dimension shall be as specified in the Contract. Consideration shall be given to temperature rise caused by the hydration of the cement. Large differences in temperature within the concrete shall be avoided.

3. Proportioning and Mix Design:

   a. Materials and mix proportioning for mass concrete shall be in accordance with ACI 207.1R - Mass Concrete, latest edition. Type III Portland cement and accelerating type admixtures shall not be used.

   b. Selection of concrete aggregates for mass concrete is of paramount importance to the quality of the concrete and to the economy and durability of the structure. Aggregates shall conform to the requirements of ASTM C 88 and C 227. Aggregate size shall be in accordance with ASTM 467.

   c. The selection of the mix design should recognize that serious volume change stresses can be avoided by controlling the temperature drop of the concrete from the maximum to ambient. Avoidance of thermal shock is important in preventing surface cracks due to temperature gradients. The maximum internal temperature will depend upon the initial concrete temperature and the type and quantity of cementitious materials used.

   d. Mixes shall be designed using types and amounts of cement which will reflect lower internal temperatures. Optimum cement is only obtainable by aggregate proportioning that reduces the volume of the void spaces and depends upon aggregate gradation. Minimum cement factors with maximum size aggregate, air entrainment and low water cement ratios should be used, to produce workable concrete and the specified strength.

4. Placement:

   a. Concrete with lower than usual slump may be used, provided it can be properly placed and consolidated.

   b. Placing Temperatures - Unless otherwise permitted or specified, the temperature of the concrete when deposited at the point of placement shall not exceed seventy (70) degrees Fahrenheit, nor be less than thirty-five (35) degrees Fahrenheit. When the temperature of the surrounding air is expected to be below forty (40) degrees Fahrenheit during placing, or within twenty-four

(24) hours thereafter, the temperature of the concrete when deposited at the point of placement shall be in accordance with ACI 306R.1.

c. Concrete shall not be placed until the installation of the temperature monitoring system has been inspected and approved by the Engineer and adequate materials for the curing and thermal protection of the concrete are on the site.

5. Curing and Protection:

a. The curing period shall be a minimum of fourteen (14) days.

b. Temperature Monitoring:

1) Thermocouples or thermistors shall be installed in mass concrete placements in sets of two located on a grid at a maximum spacing of twenty-five (25) feet on center in each direction and no closer than six (6) feet from any edge or four (4) feet from any opening. One thermocouple shall be placed at mid-depth of the concrete placement and the second thermocouple shall be located directly above the first and two (2) inches below the surface. Additional thermocouples shall be placed at exposed edges of concrete placements at fifty (50) feet on center, at mid-depth, and two (2) inches beneath the surface. Where cooling pipes are installed, thermocouples shall be located mid-way horizontally between the pipes.

2) Each wire lead shall extend a minimum of six (6) feet out of the concrete and shall be securely labeled with the location of the corresponding sensor and a tracking number.

3) Placement plans showing all temperature sensors and manufacturer's installation instructions and operating manuals for all related equipment shall be submitted to the Engineer for approval prior to concrete placement.

4) Temperature monitoring shall continue during the curing period and until the internal temperature is within twenty-five (25) degrees Fahrenheit of the ambient air temperature following the end of the curing period.

c. Thermal Control:

1) At mass concrete placements, the curing water added shall not be colder than thirty (30) degrees Fahrenheit

below the interior temperature of the concrete. If necessary, curing water shall be heated.

2) For mass concrete, large differentials of temperature between the interior of the concrete and the exterior of the concrete shall be avoided. The maximum allowable temperature differential between the interior of the concrete (core) and the exterior of the concrete (surface) shall not be more than thirty-five (35) degrees Fahrenheit. When the difference in temperature between the core and the surface (horizontal or vertical) exceeds thirty (30) degrees Fahrenheit, insulation blankets shall be added in one-half (1/2) inch layers as needed to prevent the difference from increasing. Joints in insulation blankets shall be staggered a minimum of twelve (12) inches at adjacent layers. Insulation blankets shall be placed over curing mats and moisture retaining cover. If the addition of layers of insulation are not sufficient to limit the temperature gradient to thirty-five (35) degrees Fahrenheit, the concrete placement shall be tented and heat shall be applied as needed to control the temperature gradient.

3) Thermal controls and protection shall be maintained until the interior concrete temperature is less than thirty-five (35) degrees Fahrenheit greater than the average daily ambient air temperature.

4) The rate of cooling within the interior of the concrete shall be regulated to control the temperature drop to not more than one (1) degree Fahrenheit in any period of one (1) hour and ten (10) degrees Fahrenheit in any twenty-four (24)-hour period.

5) Where insulation blankets are provided over mass concrete, at the end of the curing period they shall be removed one layer at a time at such a rate that the temperature differential between the core and the surface never exceeds thirty-five (35) degrees Fahrenheit and the cooling rate specified above is not exceeded, but not more than one (1) layer in an eight (8) hour period.

E. Concrete Repairs

1. Repair of Formed Surfaces:

a. The following defects shall be repaired in all types of formed finishes:

   1) Spalls, air bubbles, rock pockets, form depressions, and other defects which are more than 1/4 inch in depth.

   2) Holes from tie rods and other form tie systems.

   3) Fins, offsets and other projections which extend more than 1/4" beyond the designated member surface.

   4) Structural cracks, as defined by the Engineer.

   5) Non-structural cracks, as defined by the Engineer, which are greater than 0.010 inches wide. In water retaining members, elevated slabs subject to rainfall and washdown, and below grade members, any crack which shows any amount of leakage. Where it is not possible to verify that a crack is not leaking, it shall be repaired.

   6) Stains and substances marring the surface.

b. The following defects shall be repaired in smooth finish surfaces, in addition to those listed above:

   1) Spalls, air bubbles, rock pockets, form depressions, and other defects which extend to more than 1/2" in width in any direction, no matter how deep.

   2) Spalls, air bubbles, rock pockets, form depressions, and other defects of any size which exceed 3 in number in a 12 inch square or 12 in number in a 3 foot square.

   3) Fins, offsets and other projections shall be completely removed and smoothed.

   4) Scratches and gouges in the surface.

   5) Surfaces that exceed allowable tolerances.

   6) Texture and color irregularities. At water retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below the minimum normal operating water surface except where such defects are indicative of reduced durability.

c. Where a smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to the finish application, when approved by the Engineer.

2. Method of Repair of Formed Surfaces:

   a. Repair and patch defective areas with cement mortar or concrete repair mortar immediately after removal of forms and as directed by the Engineer.

   b. Repairs made to water bearing and below grade surfaces shall be made with repair mortar only. Repairs of form tie holes in water bearing or buried surfaces shall be made with non-shrink grout as specified in Section 03 60 00 - Grouting.

   c. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1 inch for cement mortar and one-half (1/2) inch for repair mortar. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean and brush-coat the area to be patched with the specified bonding agent. Where concrete repair mortar is used, the surface shall be prepared and mortar placed per manufacturers recommendations. Compact mortar in place and strike off slightly higher than the surrounding surface. Cure as specified.

   d. Repairs to surfaces exposed to public view shall match the color and texture of surrounding concrete.

   e. Provide test areas at inconspicuous locations to verify mixture, texture and color match before proceeding with the patching.

   f. Structural cracks shall be pressure grouted using epoxy injection in accordance with the manufacturer's directions and recommendations.

   g. Non-structural cracks shall be pressure grouted using hydrophilic resin in accordance with the manufacturer's directions and recommendations.

   h. Fill holes extending through concrete by means of a plunger- type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling.

   i. Remove stains, grout accumulations, sealing compounds, and other substances marring surfaces by scrubbing, power washing, or abrasive blast using sand finer than No. 30 and air pressure from fifteen (15) to twenty-five (25) psi.

3. Repair of Unformed Surfaces:

a. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish according to ACI 117. Correct low and high areas as herein specified.

b. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.

c. Repair finish of unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects include crazing, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.

d. Repair structural cracks as defined by the Engineer in all structures.

e. Repair non-structural cracks as defined by the Engineer which are greater than 0.01 inches wide, which are in below grade structures, or which are exposed to public view. In water retaining structures, repair any crack which shows any amount of leakage and all cracks where leakage potential cannot be determined.

4. Methods of Repair of Unformed Surfaces:

a. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.

b. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where the concrete has already set and repairs are required, sawcut around the perimeter of the area to be repaired to a one-half (1/2)-inch depth and remove concrete so that the minimum thickness of the repair is one-half (1/2) inch. Apply specified concrete repair mortar in accordance with the manufacturer's directions and recommendations.

c. Remove defective areas to sound concrete with clean, square cuts, to a minimum depth of one and a half (1.5) inches. Provide three-quarter (3/4)-inch clearance all around exposed reinforcing steel. Clean and dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete while the bonding agent

is still tacky. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class and color as the adjacent finished concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

d. Repair isolated random non-structural cracks in members which are not below grade or water retaining, and single holes not over one (1) inch diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack grout before the cement grout takes its initial set. Mix dry-pack grout as specified in Section 03 60 00 - Grouting, Grout. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than seventy-two (72) hours.

e. Structural cracks shall be pressure grouted using an epoxy injection system. Apply in accordance with the manufacturer's directions and recommendations.

f. Non-structural cracks in below grade and water retaining structures shall be pressure grouted using hydrophilic resin. Apply in accordance with the manufacturer's directions and recommendations.

g. Where flooring material is to be installed, assure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.

5. Other Methods of Repair:

a. Repair methods not specified above may be used with written approval of the Engineer.

F. Shotcrete

1. Shotcrete is concrete or mortar pneumatically projected at high velocity onto a surface. Shotcrete proportioning, placement, curing and testing shall be in accordance with NYCBC Section 1911, where applicable.

2. For projects where NYCBC is not applicable, ACI 506R and 506.2 guidelines shall be followed.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Quality Control Testing:

1. General:

a. Unless required otherwise by the Contract, all field quality control testing of materials and the resulting concrete for compliance with the technical requirements of the specifications shall be performed by the Division of Design Services of the Bureau of Engineering Design and Construction and/or it's QA/QC Consultant.

b. The use of these, or any, testing services shall in no way relieve the Contractor of his responsibility to furnish materials and construction in full compliance with the Contract. The Contractor shall provide concrete of the quality specified and it is hereby emphasized that the responsibility for so doing is solely and completely his. It shall be the Contractor's responsibility to work with the Supervising Engineer for Concrete Construction and the DEP designated Testing Laboratory and to keep himself fully informed of the Evaluation of the Compression Test results as described in Paragraph 3.03 B.

2. Testing Provided by DEP – at DEP's discretion, the following testing and inspection shall be provided.

a. Secure production samples of materials at plants or stockpiles during the course of the work and test for compliance with the specifications unless otherwise noted in the Schedule of Mixes Proportioning and Testing stipulated in the Contract.

b. Provide the services of a qualified concrete technician at each location on the job site where concrete is being mixed and discharged from the mixer for the duration of the concrete placement.

c. Strength Tests: The Concrete Testing Laboratory provided by DEP shall conduct all strength tests (in accordance with ASTM C39). Strength tests of the concrete shall be conducted in accordance with the following procedures.

1) Secure composite samples in accordance with ASTM C 172.

2) Each strength test shall be obtained from a different batch of concrete on a representative, truly random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

3) Additional concrete test cylinders shall be made from concrete taken out of the bucket, hopper or forms as directed by the Supervising Engineer for Concrete Construction. These test cylinders shall be separate and distinct from those made from the mixer and shall be made from the same batch as the sample taken from the mixer. Where concrete is placed directly from the mixer into forms, without any intermediate conveyance, these additional cylinders will not be required.

4) When pumping or pneumatic equipment is used, samples shall be taken at the discharge end.

5) Compressive strength tests shall be conducted on a set of four specimens molded from each sample in accordance with ASTM C 31, and cured under standard moisture and temperature conditions in accordance with ASTM C 31.

6) Test two specimens at 7 days in accordance with ASTM C 39. Test two specimen at 3 days instead of seven (7) days when high early strength is required.

7) Test three specimens at twenty-eight (28) days in accordance with ASTM C 39. The 28-day test result shall be the average of the strengths of the three (3) specimens, except that if one (1) specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the remaining two (2) strengths averaged. Should more than one specimen in a test show any of the above defects, the entire test shall be discarded. When high early strength is required, the specimens shall be tested at seven (7) days instead of twenty-eight (28) days.

8) When the seven (7)-day test results (3-day for high early strength) are below sixty-five (65) percent of the specified strength and/or whenever the twenty-eight (28)-day test results (7-day for high early strength) are below the specified strength, the specimens shall be kept intact and stored for a minimum of thirty (30) days or until inspected by both the Supervising Engineer for Concrete Construction or his authorized representative and the Contractor.

9) Written results of the compression test results shall be posted on the DEP’s concrete database twenty-four (24)

hours following the test date on the following business day. The test results are available to the Supervising Engineer for Concrete Construction, the Engineer, Contractor and concrete supplier. A hard copy of the final result will be sent to the Resident Engineer.

10) Unless otherwise directed, all cylinders shall only be handled by DEP designated personnel.

d. Other Required Tests:

1) Check the slump, air content, concrete temperature, unit weight, yield, and water content of each sample of concrete to be used in molding strength test specimens.

2) Perform all other field testing of concrete as required by the New York City Building Code.

3) Slump testing shall be conducted in accordance with ASTM C 143.

4) Air content testing shall be conducted in accordance with either ASTM C 231 (Pressure Method) or ASTM C 173 (Volumetric Method) on concrete samples from which the compressive strength test specimens are made. Note that the chase indicator is not the approved ASTM volumetric test method. Air content testing of Lightweight Concrete shall be in accordance with ASTM C 173.

5) Additional tests of air content shall be performed on a regular and frequent basis for control as directed by the Supervising Engineer for Concrete Construction. A Chase indicator, calibrated at least once daily against the readings for air content obtained by methods outlined in Article 3.03, Paragraph A.2.d.4, may be used for additional testing. Use of the Chase Indicator alone will not be considered as having met the requirements of Article 3.03, Paragraph A.2.d.1 for checking air content.

6) Measurements of concrete temperature shall be performed in accordance with ASTM C 1064.

7) Unit Weight tests shall be made with a calibrated one-half (1/2) cubic foot bucket in accordance with ASTM C 138. On obtaining the unit weight, the yield shall be immediately computed as the ratio; weight of all the ingredients batched including the water added per cubic

yard (from the batching ticket) divided by the unit weight determined times 27. Over-yielding or under-yielding by more than two (2) percent are cause for concern and should be immediately investigated.

8) Water content testing shall be conducted in accordance with AASHTO TP 23.

9) Properly note and record the time of day when all tests were made and the corresponding results. Also, record from what truckloads the samples were taken, the class of concrete which the samples represent and exactly where the concrete represented by the sample was deposited in the structure.

e. Frequency of Testing:

1) For buildings, make one strength test for each fifty (50) cubic yards or fraction thereof for each mix design placed in any one (1) day except that a minimum of two (2) tests will be made for each day's placement.

2) The minimum number of tests shown in the following table will be made for concrete used for all structures other than buildings.

Total Cubic Yards of Concrete Placed During Day	**Minimum Number of Strength Tests**
Up to 100	One for each 50 Cu. Yds.*
OVER 100 CU. YDS.	One for each 100 Cu.Yds.*
* or fraction thereof.	

3) The Supervising Engineer for Concrete Construction may require that additional tests be made.

f. Additional Services: The DEP provided testing agency shall provide additional services to the extent deemed necessary by DEP and shall also perform the following services.

1) Inspect concrete batching, mixing, and delivery operations in accordance with Inspection Requirements of the administrative building code of the City of New York.

2) Check batching and mixing operations.

3) Review the manufacturer's report of each shipment of cement, aggregates and reinforcing steel and/or conduct laboratory spot checks of these materials as received.

4) Inspect the location and dimension of the forms, the placing of the reinforcing steel and the placing, conveying and depositing of the concrete.

5) Sample concrete at point of placement and other locations directed by the Supervising Engineer for Concrete Construction and perform required tests.

6) Additional testing and inspection required because of changes in materials or mixture proportions requested by the Contractor. When required, such testing shall be performed at the Contractor's expense.

7) Additional testing of materials or concrete occasioned by failure to meet specification requirements. When required, such testing shall be performed at the Contractor's expense.

3. Authority and Duties of the DEP provided Special Inspection Testing Agency:

a. Special Inspections of concrete shall be in accordance with NYCBC Table 1704.4.

b. Technicians representing the testing agency shall inspect the materials and the manufacture of concrete and shall report their findings to the Supervising Engineer for Concrete Construction or his authorized representative and the Contractor.

c. When it appears that the material furnished or work performed by the Contractor fails to fulfill specification requirements, the technician shall immediately notify the Supervising Engineer for Concrete Construction or his authorized representative, and the Contractor of such failure.

d. The technician shall not act as foreman or perform other duties for the Contractor.

e. Technicians are not authorized to revoke, alter, relax, enlarge or release any requirement of the specifications, nor to approve or accept any portion of the work.

4. Responsibilities and Duties of the Contractor:

a. Submit data and test documentation on materials and design mixtures including trial batch and shrinkage test results to the Engineer at least 60 days prior to the start of field operations.

b. Submittal to the Supervising Engineer for Concrete Construction the procedures, methods and concrete mix designs, the name and location of the proposed concrete plant. Submit the quality assurance programs of the concrete suppliers and provide copies of all test reports to the Engineer.

c. Provide all materials, labor and equipment necessary to assist the representatives of the Owner's testing agency in obtaining, preparing and handling test samples at the project site or at other sources of material. When directed by the Engineer, the Contractor shall be responsible for transferring strength test specimens from point of casting to curing boxes and/or to testing agency vehicles.

d. Advise the Resident Engineer and the Supervising Engineer for Concrete Construction and the DEP provided Testing Agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

e. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test cylinders on the project site for the first twenty-four (24) hours, as required by ASTM C 31. The Contractor shall provide an insulated box of substantial construction for use in storing cylinders on the site until such time as they are transported to the testing laboratory. The box shall be large enough to accommodate the maximum number of test cylinders which may be required for any day's concrete placement, and shall have an insulated hinged cover. Heating facilities shall be installed in the box such that the temperature within the box may be maintained at the limits specified by ASTM C 31. The box shall be of such dimensions as to permit placing the cylinders in the box one (1) high only. No stacking of cylinders will be permitted. A high-low thermometer shall be placed in the storage box and the maximum and minimum temperatures noted shall be recorded on an appropriate identification card for each test. To minimize the hazard of disturbance during curing, the storage box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete shall be delivered on the site until such storage curing box has been provided and any identified problems with the box addressed to the satisfaction of

the Engineer. Cylinders shall remain in the curing box until ready for delivery to the testing laboratory but not less than twenty-four (24) hours. Sufficient box storage capacity shall be provided by the Contractor to allow for up to seventy-two (72) hours of cylinder storage.

f. The DEP provided Testing Agency shall deliver concrete test cylinders to the DEP designated testing laboratory, or such other location as designated in the Contract. Delivery methods shall be in accordance with the requirements of ASTM C 31. Deliveries shall be made such that cylinders remain at the job site (in the boxes provided for their storage) no less than twenty-four (24) hours and no more than seventy-two (72) hours after the casting.

g. The Contractor shall furnish copies of mill test reports of all shipments of cement, aggregates and reinforcing steel being used to Supervising Engineer for Concrete Construction and the testing agency.

h. The Contractor shall be responsible for:

1) All testing associated with the evaluation proposed mix designs including required trial batch and shrinkage testing.

2) Establishing and controlling the mix proportions during the entire progress of the work in accordance with Article 2.02, Paragraph E.

3) Testing required because of changes in materials or proportions of the mix requested by the Contractor, as well as, any extra testing of concrete or materials occasioned by failure to meet specification requirements.

B. Evaluation of Concrete Quality:

1. General:

a. Concrete quality shall include but not be limited to satisfactory strength, durability, density (air entrainment), wearing quality, shrinkage cracks, color, physical appearance etc.

b. Wherever there is evidence that any of the concrete in place does not appear to produce the results required by the specifications, such concrete shall be considered questionable and evaluations shall be made as detailed below.

2. Evaluation of Compressive Test Results:

a. Test results shall be evaluated separately, for each type and each specified strength of concrete. Evaluation shall be in accordance with the ACI 214R.

b. The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

1) Every arithmetic average of any three consecutive compressive strength tests equals or exceeds the specified compressive strength f'c.

2) No individual strength test (average of two cylinders) falls below the specified compressive strength f'c by more than 500 psi when f’c is 5,000 psi or less, or by more than 0.10 f’c when f’c is more than 5,000 psi. The strength level of the concrete will be considered satisfactory as long as the averages of all sets of three consecutive compressive strength test results equal or exceed the specified compressive strength f’c and no individual strength test result falls below the specified compressive strength f’c by more than 500 psi.

c. For evaluation of the control of the quality and uniformity, each type and specified strength of the concrete shall be represented by at least five (5) tests.

d. If results of a number of consecutive seven (7) day tests at any stage of the work indicate abnormalities or results of a number of twenty-eight (28) day tests are below the specified strengths, the production and testing of the concrete shall be immediately investigated and reported upon by the Evaluation Committee noted in Article 3.03, Paragraph B.5. It is emphasized that the report of the Evaluation Committee is advisory. The responsibility for the production of the concrete and the decision as to how to proceed with the work remain with the Contractor. However, the decision as to how to proceed is subject to review and approval by the Commissioner.

3. Evaluation of Questionable In-Place Concrete Construction by Non-destructive Methods:

a. Visual inspection, impact hammers, sonoscopes, microscopic examination, chemical analysis of the hardened concrete, probes or other nondestructive testing devices may be used as an indicator of the relative quality and uniformity of various areas of the structure, as an aide in evaluating concrete in place, or in

determining locations of areas to be cored. Any program of nondestructive testing shall be performed as directed by and under the supervision of the Evaluation Committee noted in Article 3.03, Paragraph B.5. Test results of any program of nondestructive testing and recommendations based thereon shall be reported by the Committee to the Commissioner prior to the commencement of any other program of further testing, if recommended or required. All viewpoints if there is no complete agreement, shall be noted in the report.

b. Nondestructive Tests:

1) Test results shall be evaluated and shall be valid only if tests have been conducted by properly calibrated equipment in accordance with recognized standard procedures.

2) Nondestructive tests shall not be used as the sole basis for accepting or rejecting concrete.

4. Evaluation of Questionable In-Place Concrete Construction from Core Tests:

a. Core tests shall be conducted only as recommended and directed by the Evaluation Committee noted in Article 3.03,Paragraph B.5 and only after a program of nondestructive testing as noted in Article 3.03,Paragraph B.3. Core tests shall be evaluated and shall be valid only if tests have been conducted in accordance with specified procedures.

b. When core testing is required, cores shall be obtained and tested in accordance with ASTM C 42. Cores shall be tested saturated-surface-dry or shall be tested air-dry depending as to whether the area where the questionable concrete is located shall be wet or dry under service conditions. Such determination shall be made by the Committee and they shall direct the condition of the cores at the time of testing. If the cores are to be tested dry, they shall be air dried (temperature sixty (60) to seventy (70) degrees Fahrenheit and relative humidity less than sixty (60) percent) for seven (7) days before the test. If the cores are to be tested wet, they shall be tested after moisture conditioning in accordance with ASTM C 42. The laboratory report shall state whether the cores were tested saturated-surface-dry or surface-dry.

c. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined

by the Committee so as to least impair the strength of the structure.

d. If, before testing, one (1) or more of the cores shows evidence of having been damaged subsequent to or during removal from the structure, or is obviously defective, replacement cores shall be taken.

e. Concrete in the area represented by a core test, made and tested in accordance with the specified requirements above will be considered adequate for structural strength if the average strength of the three (3) cores taken from the immediate area of the questionable concrete is equal to or greater than the specified strength and no single core strength is less than eighty-five (85) percent of the specified strength (f'c).

f. The Committee shall determine the area where the cores are to be taken and they shall determine the number of cores to demonstrate the adequacy of the questionable concrete. Corrections to the strength values shall be made if the length to the diameter ratio is different from two. No strength correction shall be made for the age of the concrete cores.

g. If the average strength of the cores as tested is less than the required value, the Committee will make a recommendation as to whether the values obtained are acceptable or they will recommend that the values obtained be checked against a structural analysis as covered in Paragraph 3.03 C.

h. Core holes shall be plugged solid as specified.

5. Evaluation Committee:

a. The following shall constitute a Committee for the investigation and the evaluation of the quality of the concrete when there are indications that the requirements of Paragraph 3.03 B are not being met. The Resident Engineer (who shall act as Chairman of the Committee), the Supervising Engineer for Concrete Construction or authorized representative, representatives of the Contractor, the Concrete Producer, the Testing Agency, the Architect/Engineer responsible for the design and such other members as the Commissioner may designate. Such members of the Committee as designated by the Chairman shall meet whenever request for such meeting is made by any member and/or as otherwise specified. Reports and recommendations of the Committee shall be submitted to the Contractor and the Commissioner. All viewpoints, if there is no complete

agreement shall be noted in the report and reports shall be countersigned by all participating members of the Committee. The Contractor shall be responsible for the preparation and submission of reports.

b. The functions of the Committee and any reports, recommendations, etc., it submits shall be advisory in nature. The responsibility for the production and quality of the concrete remains solely and completely with the Contractor.

c. All expenses incurred due to the functioning of the Committee shall be borne by the Contractor except that all members of the Committee shall serve without fee.

6. Additional Curing:

a. If the concrete fails to meet the specified compressive strength requirement, additional curing as specified by the Supervising Engineer for Concrete Construction may be required and modifications may be required in the concrete mix design for the remaining concrete work, at the expense of the Contractor, in addition to the measures outlined in Article 3.03, Paragraph B.

7. Acceptance of Concrete:

a. Concrete Strength:

1) Concrete not meeting the requirements of Article 3.03, Paragraph B.2 shall be considered potentially deficient. Steps shall be taken to increase the strength to ensure that the strength level will be satisfactory. For potentially deficient concrete, see Article 3.03, Paragraph C.

b. Air Content:

1) Concrete not within the specified limits of air entrainment and tested in accordance with Article 3.03, Paragraph B shall be rejected.

2) Steps must be made to control the proper air content.

c. Slump:

1) Concrete not within the specified slump limits at the point of placement may be rejected.

2) When the concrete is tested and found to be out of specifications the Contractor shall immediately adjust the mix to bring the mixture within the specified slump limits.

d. Acceptance of Lightweight Concrete shall be based on fresh unit weight measured in accordance with ASTM C 138. The nominal fresh unit weight shall be that corresponding to the specified maximum air-dry unit weight calculated from the formula for approximate air-dry weight in ASTM C 567. When the nominal fresh unit weight varies by more than two (2) pounds per foot from the required weight, adjust the mixture as promptly as conditions permit to bring the unit weight to the desired level. Do not use any batch for which fresh unit weight varies by more than three (3) pounds per foot from the desired level.

C. Acceptance of Structure:

1. General:

a. Notwithstanding the provisions of any section of this Contract, all concrete shall conform to the requirements of the New York City Building Code.

b. Completed concrete Work which meets all applicable requirements will be accepted without qualification.

c. Completed Concrete Work which fails to meet one or more requirements shall be considered potentially deficient. Potentially deficient concrete which has been repaired to bring it into compliance will be accepted without qualification. The decision as to whether it has been brought into compliance except as otherwise noted in this Section shall rest with the Supervising Engineer for Inspection subject to approval of the Commissioner and the Building Department.

d. Potentially deficient concrete which cannot be brought into compliance shall be evaluated by the Committee noted in Article 3.03, Paragraph B and a report submitted to the Commissioner. The Commissioner will then, in writing, either accept without qualification or accept subject to Retainage (as outlined in Article 3.03, Paragraph .C.8) or direct that the concrete be reinforced or supplemented with additional construction to bring it into compliance after which it may be resubmitted to the Commissioner.

e. Repair potentially deficient concrete Work by removing and replacing or by reinforcing with additional construction as required by the Engineer. To bring the rejected Work into compliance, use repair methods that will maintain the strength of the structure and meet all other applicable requirements for function, durability, dimensional tolerances, and appearance.

f. Obtain acceptance by the Engineer for repair methods and materials and for modifications needed to ensure that concrete work complies with requirements in the Contract Documents.

g. The Contractor shall pay all costs incurred including redesign and reverification in bringing the concrete Work into compliance and acceptance.

2. Dimensional Tolerances:

a. Formed surfaces resulting in concrete outlines smaller than required by an amount exceeding the requirements of Section 3.3 of ACI 347R shall be considered deficient in strength and subject to the provisions of Article 3.03, Paragraph C.4.

b. Formed surfaces resulting in concrete outlines larger than required, by an amount exceeding the requirements of Section 3.3 of ACI 347R may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.

c. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

d. Inaccurately formed concrete surfaces exceeding the requirements of Section 3.3 ACI 347R and which are exposed to view may be rejected and shall be repaired or removed and replaced if required.

3. Appearance:

a. Concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired, if possible. If, in the opinion of the Supervising Engineer for Concrete Construction, the defects cannot be repaired, the concrete shall be considered potentially deficient, such concrete shall be evaluated by the Committee noted in Article 3.03.B and a report submitted to the Commissioner. The Commissioner will then in writing, either accept without qualification or accept subject to Retainage (as outlined in Article 3.03, Paragraph C.8) or direct that other remedial measures be taken after which it may be resubmitted to the Commissioner.

4. Strength of Structure:

a. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:

1) Low concrete compression test strength as evaluated by Article 3.03, Paragraph B above. However, in those areas or members containing such concrete, if a structural analysis by the architect/engineer indicates the completed structure will be suitable for its intended use, i.e., that the stresses which will be developed under design load in the members containing below-strength concrete are less than the design stress permitted for the actual compression test strengths reported and the analysis is approved by the Building Department, the member or members will be accepted without qualification.

2) Low concrete core tests as evaluated by Article 3.03, Paragraph B above. However, in those areas or members where core tests are made in accordance with Article 3.03, Paragraph B.4, if a structural analysis by the architect/engineer indicates the suitability of the structure for its intended use, i.e., that the stresses which will be developed under design load in the members containing below-strength concrete are less than the design stress permitted for the actual core test strengths reported, and the analysis is approved by the Building Department, the areas or members will be accepted without qualification.

3) Reinforcing steel size, quantity, strength, position or arrangement at variance with the specified requirements or the Contract Drawings.

4) Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.

5) Curing less than specified.

6) Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

7) Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.

8) Poor workmanship likely to result in deficient strength.

5. Action Required When Strength Is Potentially Deficient:

a. When the strength of the structure is considered potentially deficient, the following actions may be required by the Engineer/Architect:

1) Structural analysis or additional testing or both may be required.

2) Core tests may be required.

3) If testing is inconclusive or impractical or if structural analysis does not confirm the Safety of the structure, load tests may be required and their results evaluated in accordance with ACI 318.

4) Concrete Work rejected by structural analysis or by results of a load test shall be reinforced with additional construction as required by the Engineer/Architect, or replaced.

5) Document all repair work performed to bring strength-deficient concrete work into compliance with Contract Documents, and submit the documentation to the Engineer/Architect for acceptance.

6. Durability:

a. The durability of the concrete work will be considered deficient and therefore the concrete work shall be rejected, if it fails to comply with any of the requirements which control the durability of the structure, including, but not necessarily limited to, the following conditions:

1) Strength failing to comply with Article 3.03, Paragraph B above.

2) Materials for concrete not conforming with the specified requirements of Article 3.03, Paragraph C.2. above.

3) Concrete not conforming with either the specified air-entrainment requirements or the air content limits.

4) Curing not accomplished in accordance with Contract Documents.

5) Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

7. Withholding:

    a. Where concrete is placed which is considered to be deficient, whether in strength, appearance, durability or any other quality defined, payment may be withheld at the discretion of the Supervising Engineer for Concrete Construction. If such concrete is subsequently accepted without qualification, then payment shall be made for such concrete including return of all monies withheld.

8. Retainage:

    a. Deficient concrete which cannot be brought into compliance and is nevertheless accepted by the Commissioner shall be subject to the following permanent retainage. For every cubic yard of concrete so placed, an amount equal to ten (10) percent of the unit price for concrete in place for unit price contracts or ten (10) percent of the price established in the detailed estimate for concrete in place for lump sum contracts shall be permanently retained.

9. Rejected Concrete:

    a. Concrete which has been rejected, in writing, by the Commissioner, shall be removed and replaced. The cost of all such removed and replaced concrete shall be borne by the Contractor.

10. Protection of In-Place Concrete:

    a. Loading and Support of Concrete:

        1) Do not allow construction loads to exceed the superimposed load which the member, with necessary supplemental support, is capable of carrying safely and without damage. Submit for acceptance data on the amount of loading, method of distributing load, and any proposed supplemental support during construction.

    b. Protection from Mechanical Injury:

        1) During the curing period, protect, the Contractor shall protect the concrete and its shoring from damaging mechanical equipment inducing shock and vibrations at all times. Protect all concrete surfaces from damage by construction traffic, equipment, materials, rain or running water, and other adverse weather conditions.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

The items below are found on the following pages:

“Table 1 -- Concrete Mix Requirements”

Sample Concrete Placement Card

Mix Design Submittal (MDS) Forms

TABLE 1 - CONCRETE MIX REQUIREMENTS

Classes of Concrete	Coarse Aggregate Sizes (ASTM C 33)			Minimum Cementitious Materials (lbs/cu yd.)	Cement Type (ASTM C 150)	Mineral Admixtures (%)		W/(C + P) Maximum	Specified Strength (psi)		Maximum Permissible GWP (Kg CO2e/m3)
	A	B	C			A	B		fc minimum field condition	f_{cr} minimum for mix design See FN3	
50	#67 (3/4" to No. 4)	#8	---	550	III	See FN 1	---	0.42	6,000 at 28 days	7,300 at 28 days	319
50	#67 (3/4" to No. 4)	#8	---	550	III	See FN 1	---	0.42	5,000 at 28 days	6,200 at 28 days	305
45	#57 (1" to No. 4)	#8	---	525	II	---	---	0.42	4,500 at 28 days	5,700 at 28 days	284
45F	#4 (1.5" to 3/4")	#67	#8	525	II	See FN 2	---	0.41	4,500 at 56 days	5,700 at 56 days	284
40LW	3/4" to No. 4	---	---	525	I or II	---	---	0.45	4,000 at 28 days	5,200 at 28 days	284
45PG	3/8” to No. 16	#8	---	660	II	---	---	0.40	4,500 at 28 days	5,700 at 28 days	284
35	#57	---	---	376	II	---	---	0.44	3,500 at 28 days	4,000 at 28 days	284
25	#57 to #67	---	---	376	II	See FN 2	---	0.60	2,500 at 28 days	3,500 at 28 days	228

Note: Concrete containing coarse aggregate smaller than #67 shall only be used with the approval of the Engineer.

Footnotes (FN) to Table 1:

1. At the Contractor's option, and as approved by the Engineer, up to 15% fly ash and 20% GGBF may be used in Class 50 concrete that will not be in contact with potable water.
2. At the Contractor's option, and as approved by the Engineer, up to 15% fly ash and 20% GGBF may be used in Class 25 and Class 45F concrete that will not be in contact with potable water.
3. Minimum $\mathbf{f_{cr}}$ for mix design listed in this column are based on ACI 301, Table 4.2.3.1; when data are not available to establish standard deviation.

END OF SECTION

SAMPLE CONCRETE PLACEMENT CARD

Contract:	**Contractor:**		
Placement Date:		**Concrete Mix:**	
Scheduled Start Time:		**Approximate Quantity:**	**cu. yds.**
Identification of Placement: **Placement No:**			
Item	**Initials** **Inspector**	**Date**	**Remarks**
Foundations			
Construction Joint Preparation			
Forms and Blockouts			
Waterstops			
Reinforcement			
Embedments/Anchor Bolts			
Piping/Test			
Temperature Checkout			
Cleanup			
Provisions for Weather			
Contractor			
Electrical Contractor			
HVAC Contractor			
Plumbing Contractor			
Structures Contractor			

Mix Design
Proportions Summary Sheet
MDS

- USE ONE FORM PER MIX DESIGN -

Contract:	Mix Design Code (DEP Only):	Class (Specified Strength): PSI + %	Proposed Trial Batch Date:	Submittal Date:
Contractor:	Concrete Supplier:		Testing Laboratory:	
Mix Description (Common Name)	Concrete Supplier Address:		Testing Laboratory Address:	
	City: / State: / Postal Code:		City: / State: / Postal Code:	

Expedite:	Application:	Field Inspection:	Weight Type:	Fly Ash:	Field Curing:
☐ Yes (Comment Reqd.) ☐ No	☐ Structural ☐ Non-structural	☐ Yes (Controlled) ☐ No (Uncontrolled)	☐ Normal ☐ Lightweight	☐ Yes, List %: ☐ No	☐ Yes, Min. Days: ☐ No

Specimen Transport, Testing & Disposal Ages (Use Comments Area, If Applicable):	No. of Specimens (Per Set)	Transport Age (Days)	Test Age (No. of Specimens at Days)						Disposal Age for Unused Specimens (Days)
			Preliminary		Final		Other(s)		
			Qty	Days	Qty	Days	Qty	Days	
☐ Yes ☐ No CQAP Standard	5	2	2	7	3	28	-	-	28
☐ Yes ☐ No Other:									

Cement /Slag /Fly Ash		
Grade/Class:	Source:	PCY:

Cement/Slag /Fly Ash		
Grade/Class:	Source:	PCY:

Crushed Stone		
Size Number:	Source:	PCY (SSD):

Crushed Stone		
Size Number:	Source:	PCY (SSD):

Sand			
Type:	Source:	FM:	PCY (SSD):

Water		
	PCY:	GAL/CY:

Air Entraining Admixture		
Designation:	Brand:	OZ/CY:

_____-Range Water Reducing Agent		
Designation:	Brand:	OZ/CY:

Water-Reducing/Retarding Agent		
Designation:	Brand:	OZ/CY:

Other Admixtures		
Designation:	Brand:	OZ/CY:
Designation:	Brand:	OZ/CY:
Designation:	Brand:	OZ/CY:

Specified Slump (IN):	Specified Air Content (%):	Yield (CY):	Theoretical Unit Weight (PCF):	Water-Cement Ratio (from trial batch):

Comments:

- SUBMIT TO NYCDEP CQAP AT 1-800-673-2816 -

Submitted By (Print): Testing Laboratory: Signature: Date:

Mix Design
Submittal of Proportions
MDS

Contract:	Mix Design Code (DEP Only):	Class (Specified Strength): PSI + %	Proposed Trial Batch Date:	Submittal Date:
Contractor:	Concrete Supplier:		Testing Laboratory:	

Cement (ASTM C150)

Type:	Sp. Gr.:	Class/Grade:	Source:	Total Mass Per CY (PCY):	Volume (CU FT):

Other Cementitious Materials (ASTM C18)

Type:	Sp. Gr.:	Class/Grade:	Source:	Total Mass Per CY (PCY):	Volume (CU FT):

Aggregate No. 1, Fine (ASTM C33)

Type:	SSD Sp. Gr.:	Size:	Source:	Total Mass Per CY (PCY):	Volume (CU FT):

Dry Rodded Unit WT (PCF):	Absorption (%):	FM:

Aggregate No. 2, Coarse (ASTM C33)

Type:	SSD Sp. Gr.:	Size:	Source:	Total Mass Per CY (PCY):	Volume (CU FT):

Dry Rodded Unit WT (PCF):	Absorption (%):	

Aggregate No. 3, 4 Coarse (ASTM C33)

Type:	SSD Sp. Gr.:	Size:	Source:	Total Mass Per CY (PCY):	Volume (CU FT):

Dry Rodded Unit WT (PCF):	Absorption (%):	

Aggregate No. 2, Lightweight Alternative (ASTM C330)

Type:	Sp. Gr. Factor:	Size:	Source:	Oven Dry (PCY):	Volume (CU FT):

Loose Unit WT (PCF):	Estimated Wet (PCF):	

Chemical Admixtures (OZ/CY)

No. 1 ASTM C:	Type:	Source:	Name:	WT (OZ):
No. 2 ASTM C:	Type:	Source:	Name:	WT (OZ):
No. 3 ASTM C:	Type:	Source:	Name:	WT (OZ):

Water (Total)			Air Content		Total Mixture Mass and Volume	
GAL:	PCY:	CU FT:	%:	CU FT:	LB/CU FT:	CU FT:

Comments:

Submitted By (Print): Company: Signature: Date:

Mix Design
Aggregates Gradation
MDS

Sieve Size	Percent Passing Aggregate No.								
	1 (Fine)		2 (Coarse) Stone Size (no):_____		3 (Coarse) Stone Size (no):_____		4 (Coarse) Stone Size (no):_____		Combined Gradation
	Per ASTM C33:	Tested:	Per ASTM C33:	Tested:	Per ASTM C33:	Tested:	Per ASTM C33:	Tested:	
3 IN									
2 1/2 IN									
2 IN									
1 1/2 IN									
1 IN	-								
3/4 IN	-								
1/2 IN	-								
3/8 IN	100								
1/4 IN	-								
#4	95-100								
#8	80-100								
#16	50-85								
#30	25-60								
#50	5-30								
#100	0-10								
Dry Unit WT (PCF)									
Absorption (%)									
FM									

Remarks:

Mix Design
Trial Batches Proportions
MDS

Material (Trial Batch Proportions Per Cubic Yard)			Trial Batch No. #1	#2	#3	#4
1. Cement						
Type:	Source:		LB:	LB:	LB:	LB:
2. Other Cementitious Material						
Type:	Source:		LB:	LB:	LB:	LB:
Grade/Class:						
3. Aggregate No. 1 (Fine) SSD						
Type:	Source:		LB:	LB:	LB:	LB:
Sp. Gr.:	FM:	Absorption (%):				
4. Aggregate No. 2 (Coarse) SSD						
Type:	Source:		LB:	LB:	LB:	LB:
Sp. Gr.:	Size:	Absorption (%):				
5. Aggregate No. 3 & 4 (Coarse) SSD						
Type:	Source:		LB:	LB:	LB:	LB:
Sp. Gr.:	Size:	Absorption (%):				
6. Aggregate No. 2 (Lightweight, Alternative)						
Type:	Source:		Oven Dry: LB:	LB:	LB:	LB:
Sp. Gr.:	Size:	Absorption (%):	Wet: LB:	LB:	LB:	LB:
7. Water (Total):			LB:	LB:	LB:	LB:
8. Water-Cementitious Ratio:						
9. Chemical Admixtures						
No. 1 Type:			WT (OZ):	WT (OZ):	WT (OZ):	WT (OZ):
No. 2 Type:			WT (OZ):	WT (OZ):	WT (OZ):	WT (OZ):
No. 3 Type:			WT (OZ):	WT (OZ):	WT (OZ):	WT (OZ):
10. Total Mass			LB:	LB:	LB:	LB:
11. Total Mass Per Cubic Foot (Theoretical Unit Weight)			PCF:	PCF:	PCF:	PCF:

Mix Design
Mixture Properties
MDS

Properties	ASTM	Target Per Specification	Trial Batch No.			
			#1	#2	#3	#4
1. Fresh Concrete						
Temperature (F):	C1064					
Slump (IN):	C143					
Before Add HRWR						
End of Mixing						
15 (MIN)						
30 (MIN)						
45 (MIN)						
1 (HR)						
Unit WT (PCF):	C138					
Air Content (%):	C231/C173					
Mortar Content (%):						
Yield (CU FT/CU YD):						
Water-Cementitious Ratio						
Time of Set (MIN):	C403					
Initial (MIN):						
Final (MIN):						
Difference (MIN):						
2. Hardened Concrete						
Cylinder No.			1 (A-)	2 (A-)	3 (A-)	4 (A-)
Compressive Strength (PSI):	C39/C192					
3 Days						
Specimen 1						
Specimen 2						
Average						
7 Days						
Specimen 1						
Specimen 2						
Average						
28 Days						
Specimen 1						
Specimen 2						
Specimen 3						
Average						

Mix Design
Mixture Properties
MDS

Properties	ASTM	Target Per Specification	Trial Batch No.			
			#1	#2	#3	#4
56 Days (If Required by Contract Only)						
Specimen 1						
Specimen 2						
Average						
Shrinkage (%):	C157					
_____ Days						
Specimen 1						
Specimen 2						
Average						
_____ Days						
Specimen 1						
Specimen 2						
Average						
Observations						
Color						
Bleeding						
Heat Signature (If Specified in the Specification and for the Submitted Batch Only)						

Trial Batch No. (Submitted and Recommended for Approval):

Comments:

Laboratory Director (Print):	Company:	Signature & Seal:	Date:
CQAP WITNESS (Print):	Company:	Signature:	Date:
Contractor (Print):	Company:	Signature:	Date:
Designer Of Record (Print):	Company:	Signature:	Date:

Mix Design
Laboratory Trial Batch Mix Design Data
MDS

- TO BE COMPLETED BY CQAP -

Contract No.	Contract Name:	Basic Description of Specified Mix Design (Mix Design Common Name):	Trial Batch Date:
Batch Plant Name:	Design Trial Lab Name:	Class (Specified Strength): PSI + %	Weight Type: ☐ Normal ☐ Lightweight
			Concrete Type: ☐ Pump ☐ Conventional

Description				Weight Per Cubic Yard			
Mix Point No.:				1	2	3	4
Cement:			LBS				
Cementitious:			LBS				
Sand:			LBS				
Stone:			LBS				
Stone:			LBS				
Water:			GAL				
Water:			LBS				
Admixture:		Air	OZ				
Admixture:		HRWR/MRWR	OZ				
Unit Weight:			PCF				

Description				Laboratory Trial Batch Weights			
Mix Point No.:				1	2	3	4
Cement:			LBS				
Cementitious:							
Sand:			LBS				
Stone:			LBS				
Stone:			LBS				
Water:			LBS				
Admixture:		Air	ML				
Admixture:		HRWR/MRWR	ML				

Description			Trial Batch Results							
Mix Point No.:			1		2		3		4	
Time:			Initial	30 MIN	Initial	30 MIN	Initial	30 MIN	Initial	30 MIN
Slump:		IN								
Water Content:		LBS								
Water Used:		LBS								
Computed Mix Water:		LBS								
Total Mix Water:		LBS								
Unit Weight:		LBS								
		PCF								
Air:		%								
Temp:		DEG								
Actual W/C Ratio										

Comments:

CQAP WITNESS (Print):	Company:	Signature:	Date:

Mix Design
Trial Batch Strength Test Results Form
ASTM C39 / C192

- TO BE COMPLETED BY CQAP -

Contract No.	Contract Name:	Design Trial Lab Name:	Class (Specified Strength): PSI + %	Trial Batch Date:

Preliminary Strength Testing (See Page 1 for Preliminary Strength Age):

Age of Specimen:	Trial Batch #1 (Maximum Load / PSI)	Trial Batch #2 (Maximum Load / PSI)	Trial Batch #3 (Maximum Load / PSI)	Trial Batch #4 (Maximum Load / PSI)
Testing Date:	#1	#2	#3	#4
Specimen 1				
Specimen 2				
Specimen 3				
Average				

Comments:

CQAP WITNESS (Print):	Company:	Signature:	Date:

Final Strength Testing (See Page 1 for Final Strength Age):

Age of Specimen:	Trial Batch #1 (Maximum Load / PSI)	Trial Batch #2 (Maximum Load / PSI)	Trial Batch #3 (Maximum Load / PSI)	Trial Batch #4 (Maximum Load / PSI)
Testing Date:	#1	#2	#3	#4
Specimen 1				
Specimen 2				
Specimen 3				
Average				

Comments:

CQAP WITNESS (Print):	Company:	Signature:	Date:

CQAP CPM Comments (Preliminary & Final Age Testing):

CQAP CPM (Print):	Company:	Signature:	Date:

Mix Design

Trial Batch Strength Test Results Form
ASTM C39 / C192

- TO BE COMPLETED BY CQAP -

Contract No.	Contract Name:	Design Trial Lab Name:	Class (Specified Strength): PSI + %	Trial Batch Date:

Additional Strength Testing:

Age of Specimen:	Trial Batch #1 (Maximum Load / PSI)	Trial Batch #2 (Maximum Load / PSI)	Trial Batch #3 (Maximum Load / PSI)	Trial Batch #4 (Maximum Load / PSI)
Testing Date:	#1	#2	#3	#4
Specimen 1				
Specimen 2				
Specimen 3				
Average				

Comments:

CQAP WITNESS (Print): Company: Signature: Date:

Additional Strength Testing:

Age of Specimen:	Trial Batch #1 (Maximum Load / PSI)	Trial Batch #2 (Maximum Load / PSI)	Trial Batch #3 (Maximum Load / PSI)	Trial Batch #4 (Maximum Load / PSI)
Testing Date:	#1	#2	#3	#4
Specimen 1				
Specimen 2				
Specimen 3				
Average				

Comments:

CQAP WITNESS (Print): Company: Signature: Date:

CQAP CPM Comments (Preliminary & Final Age Testing):

CQAP CPM (Print): Company: Signature: Date:

SECTION 03 32 00 - JOINTS IN CONCRETE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Work specified in this Section consists of providing all labor, materials, and incidentals necessary to furnish and install joints, joint materials, waterstops and embedded items as indicated on the Contract Drawings, specified herein and as needed for a complete installation.

B. Joints shall comply with the requirements of Section 03 10 00 - Concrete Forming and Accessories.

C. Types of joints in concrete shall be as follows:

1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.

2. Control Joints - Joints formed in concrete to provide a weakened plane in the concrete section to control formation of shrinkage cracks.

3. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Implementation	11
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	16
3.05	Adjusting / Protection / Cleanup	16

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 - Sustainability Certification Project Requirements

B. Section 03 10 00 - Concrete Forming and Accessories

C. Section 03 30 00 - Cast-in-Place Concrete.

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1. ASTM C 990 - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

2. ASTM C 1016 - Test Method for Determination of Water Absorption of Sealant Backing (Joint Filler) Material.

3. ASTM D 545 - Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

4. ASTM D 994 - Preformed Expansion Joint Fillers for Concrete (Bituminous Type).

5. ASTM D 1190 - Concrete Joint Sealer, Hot-Applied Elastic Type.

6. ASTM D 1191 - Test Methods for Concrete Joint Sealers.

7. ASTM D 1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

8. ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

9. ASTM D 2835 - Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.

10. ASTM D 5329 - Test Methods for Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.

11. ASTM D 5973 - Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing.
12. ASTM D 5898 - Guide for Standard Details for Adhered Sheet Waterproofing.
13. ASTM E 1612 - Preformed Architectural Compression Seals for Buildings and Parking Structures.
14. ASTM E 1783 - Preformed Architectural Strip Seals for Buildings and Parking Structures.
15. ASTM F 1123 - Non-Metallic Expansion Joints.
16. ACI 318 - Building Code Requirements for Structural Concrete.
17. ISO 14025 - Environmental labels and declarations - Type III environmental declarations
18. New York City Building Code.
19. NYC Department of Transportation, Standard Highway Specifications.
20. U.S. Army Corps of Engineers Specifications for Polyvinyl Chloride Waterstops, CRD-C572.

1.05 DESCRIPTION

A. The Contractor shall install joint material per the construction schedule submitted to and approved by the Engineer in a sequence and manner that will not damage the Work.

1.06 QUALITY ASSURANCE

A. Reviews of Shop Drawings shall be obtained before custom fabrication is started and before delivery of materials to the Project Site.

B. Work of this Section shall be coordinated with the Work of other trades so that construction is not delayed.

C. Joint installation procedures and health and safety of the work force shall be the responsibility of the Contractor. The requirements of authorities having jurisdiction shall be complied with.

D. The final responsibility for constructing a watertight condition at expansion joints and construction joints remains with the Contractor as part of the Work under this Contract. Errors of detailing and fabrication and for the correct fit of the Work shall be the responsibility of the Contractor.

E. Defective Work, as determined by the Engineer, shall be remedied by cutting and rebuilding the concrete walls and slabs, replacing the waterstop assemblies or other methods as approved by the Engineer.

1.07 SUBMITTALS

A. Contractor shall submit Shop drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Information as shown on the Contract Drawings and at the Site, where necessary.

2. Sizes, sections, reinforcement and dimension of units, the jointing, dowels, anchors, etc., and all other necessary details.

3. Installation of joints, including various connections, anchorage details, special jointing, the Contractor's proposed construction and control joints, and other accessories as required to complete the Work.

4. Prior to installation, the Contractor shall submit layout drawings for approval, showing the extent of the waterstop installations that are proposed to ensure that all construction and expansion joints, in water-containing structures, will be watertight. The drawings shall include elevations, sections, etc., and all details to show that a continuous watertight installation is provided.

5. Equipment pad layout drawings.

B. Manufacturer's specifications and installation instructions for each type of required joint and accessory shall be submitted. These include expansion joint fillers, expansion joint sealers, waterstops, shapes of waterstops, chemical retarders, adhesives, sleeves, inserts, anchors, embedded items, and similar items.

C. The Contractor shall submit to the Engineer one sample of each type of waterstop. Each sample shall include a splice.

D. Method to be used to roughen construction joints and achieve bond including product identification as applicable.

E. Applicator's Qualifications.

F. Proof of satisfactory field service of sealants.

G. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's

approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the Work.

B. Materials shall be stored and protected in a clean, properly drained location and shall be kept off the ground under a weather-tight covering permitting good air circulation. Materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure. The maximum uniform distributed storage load shall not exceed twenty (20) pounds per square foot.

C. Materials shall be protected before, during and after installation to ensure acceptable finished Work. In-place materials and other Work in connection with the joint installations shall be protected.

D. Material shall be handled safely in a manner that will prevent distortion or other damage. Care shall be exercised at all times to avoid damage through careless handling during unloading, storing and installing.

E. In the event of damage to the Work, necessary repairs or replacements shall be performed until satisfactory work is met at no expense to DEP.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Concrete Bonding Agent

1. The concrete bonding agent shall be:

a. Corr-Bond, as manufactured by Euclid Chemical, East Brunswick, NJ.

b. Armatec 110, as manufactured by Sika Chemical Company, Lyndhurst, NJ

c. Or approved equal

B. Expansion joint fillers (Type I) shall be:

1. Type FF-7 cross-linked, closed cell polyethylene, as manufactured by Progress Unlimited Inc., Lynbrook, NY.

2. Type W, cross-linked, closed cell polyethylene, as manufactured by Hydrozo/Jeene, Inc, Lincoln, NE.

3. Or approved equal

C. Joint Sealants:

1. Type A shall be

a. Sikaflex-2C NS/SL as manufactured by Sika Corporation, Lyndhurst, NY.

b. Sonolastic SL-1, as manufactured by Sonneborn/Master Business Solution, Parsippany, NJ.,

c. Permapol RC-270 Resevoir Sealant, as manufactured by Products Research and Chemical Company, (now is Courtaulds, PLC,) London W1A2BB, England.

d. Or approved equal.

2. Type B shall be

a. Magnum NS-100, as manufactured by Tamms Industries, Kirkland, IL.

b. Sikaflex 1A, Sika Corporation, Lyndhurst, NY.

c. Or approved equal.

3. Type C shall be

a. Sonolastic Two-part, as manufactured by Sonneborn/Master Business Solution, Parsippany, NJ.

b. Hornflex-L, as manufactured by Tamms Industries, Kirkland, IL.

c. Cormax PSC, as manufactured by DuPont, (Multiple locations in USA).

d. Or approved equal.

D. PVC waterstops shall be:

1. Model 679 for construction joints and Model 738 for expansion joints, as manufactured by Greenstreak/Sika Corp USA, Lyndhurst, NJ.

2. Or approved equal.

E. Hydrophilic Rubber Waterstops shall be:

1. Duroseal Gasket, Type 2010, as manufactured by BBZ USA, Inc, St. Louis, MO
2. Adeka Ultraseal MC-2010M, as manufactured by Asahi Denka Kogyo KK, Japan
3. Or approved equal.

F. Hydrophilic Sealant shall be:

1. Duroseal Paste, by BBZ USA, Inc, St. Louis, MO.
2. Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K, Japan.
3. Sika Swell S, by Sika Corporation, Lyndhurst, NJ.
4. Or approved equal.

G. Hydrophilic Injection Resin shall be:

1. Duroseal Inject 1K/2K, by BBZ, USA, Inc., St. Louis, MO.
2. Sika Injection 29 by Sika Corporation, Lyndhurst, NJ.
3. Or approved equal.

H. Injection Hose Waterstops shall be:

1. Fuko Injection System, as manufactured by BBZ USA Inc., St. Louis, MO.
2. Sika Swell Hose as manufactured by Sika Corporation, Lyndhurst, NJ.
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

1. Concrete Bonding Agent
   a. The concrete bonding agent product and manufacturer shall be as specified in this Section.
   b. Surface preparation, application and curing shall be performed in strict accordance with the manufacturer’s directions.

B. Performed Expansion Joint Filler

1. Preformed expansion joint filler shall be nonextruding, and shall be of the following types:
   a. Type I Sponge Rubber, conforming to ASTM D 1752, Type I.
   b. Type II Cork, Conforming to ASTM Designation D 1752, Type II.
   c. Type III Self-expanding cork, conforming to ASTM Designation D 1752, Type III.

d. Type IV Bituminous Fiber, conforming to ASTM Designation D 1751.

2. Expansion joint fillers (Type I) product and manufacturer shall be as specified in this Section.

3. Unless otherwise specified, Type II and Type III shall conform to the requirements of the Standard Highway Specifications of the NYC Department of Transportation..

4. Asphaltic blown joint filler for sealing joints over Type IV preformed joint filler shall comply with the requirements of Section 2.16 of the Standard Highway Specifications of the NYC Department of Transportation.

C. Joint Sealants

1. Type A: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C 920, Type M, Grade NS, Class 25, use NT, M, A, and O Capable of withstanding 50% in extension or compression shall be as specified in this Section

2. Type B: Single component polyurethane sealant meeting ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, A, and O, capable of withstanding 25% in extension or compression shall be as specified in this Section.

3. Type C: Multi-component chemical resistant polysulfide sealant conforming to ASTM C 920, Type M, Grade NS, Class 25 shall be as specified in this Section

D. Backer Rod

1. Backer rod shall be an extruded closed-cell polyethylene foam rod. The material shall be compatible with the sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately twenty-five (25) percent at eight (8) psi. The rod shall be 1/8-inch larger in diameter than the joint width at joints less than 3/4-inch wide and 1/4-inch larger in diameter at joints 3/4-inch end wider.

E. PVC Waterstops

1. PVC waterstops shall be manufactured from virgin polyvinylchloride and shall meet or exceed all requirements set forth in the U.S. Army Corps of Engineers Specification CRD C 572.

2. All PVC waterstops shall be of polyvinylchloride extruded from an elastomeric plastic compound of which the basis resin shall be polyvinylchloride. The compound shall contain any additional resins, plasticizers, stabilizers or other materials needed to ensure qualities which will meet the requirements herein specified.

3. The required minimum physical characteristics for this material are:

a. Tensile strength 1,750 psi

b. Ultimate elongation not less than 280%.

4. No reclaimed PVC materials shall be used for manufacture of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

5. PVC waterstops for construction joints shall be flat ribbed type, six (6) inches wide unless otherwise shown on the Contract Drawings, with a minimum thickness at any point of 3/8 inches.

6. PVC waterstops for expansion joints shall be ribbed with a center bulb, nine (9) inches wide with a minimum thickness at any point of 3/8 inches. The center bulb shall have an O.D. not less than 1-3/8 inches.

7. All PVC waterstops shall have an integral fastening system consisting of hog rings and grommets.

8. PVC waterstops product and manufacturer shall be as specified in this Section.

F. Hydrophilic Rubber Waterstop

1. Hydrophilic rubber waterstop materials shall be bentonite-free and shall expand by a minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast. For location, see the Contract Drawings.

2. The material shall be composed of resins and polymers which absorb water and cause an increase in volume in a completely reversible and repeatable process. The waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.

3. Hydrophilic rubber waterstop shall be solid rectangular shape with minimum cross sectional dimensions of 3/8-inch by 3/4-inch.

4. Hydrophilic Rubber Waterstops product and manufacturer shall be as specified in this Section.

G. Hydrophilic Sealant

1. The Hydrophilic Sealants shall adhere firmly to concrete, metal and PVC in dry or damp conditions. When cured, it shall be elastic indefinitely.

2. Hydrophilic Sealants product and manufacturer shall be as specified in this Section.

H. Hydrophilic Injection Resin

1. Hydrophilic injection resin shall be acrylate-ester based. Its viscosity shall be less than fifty (50) cps. It shall be water soluble in its uncured state, solvent free, and non-water reactive. In the cured state, it shall form a solid hydrophilic flexible material which is resistant to permanent water pressure and shall not attack bitumen, joint sealants or concrete.

2. Hydrophilic Injection Resin product and manufacturer shall be as specified in this Section.

I. Injection Hose Water Stop

1. Injection hose shall consist of a PVC or neoprene central core of sufficient strength to resist the weight of a minimum of twenty-five (25) feet of fresh concrete placed upon it. Injection openings shall be provided closely spaced along the length of the hose and in a minimum of three (3) locations equally spaced around the perimeter of the hose. The openings shall be sealed by strips of closed cell foam of a consistency to act as one-way valves preventing entrance of cement paste while allowing free flow of injection material, pumped through the hose, into the concrete joint surface.

2. Injection hose system shall be appropriate for the injection of hydrophilic injection resin. The hose shall allow for vacuuming operations and repeated use. The construction of the hose shall permit free discharge of the specified injected grout into the concrete without backwash, for the entire length of the hose.

3. Injection hose system shall be complete with hold-down clips, connection tubes, fittings and injection connections designed to be mounted flush with the concrete surface and sealed to allow for future injections. All components of the system shall be provided by the same manufacturer.

4. Injection Hose Waterstops product and manufacturer shall be as specified in this Section.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements

1. Prior to commencement of the Work, existing dimensions, elevations, locations and conditions applicable to the Work shall be field verified. Variances and discrepancies from the Contract Drawings and potential interferences shall be reported promptly to the Engineer.

2. Sufficient field measurements shall be taken prior to preparation of Shop Drawings and fabrication of construction materials, where possible, to ensure proper fitting of the Work. However, job progress shall not be delayed. Allow for adjustments and fittings wherever the taking of field

measurements before fabrication may not be possible or might delay the Work.

3. Actual field-verified conditions may require modifications to the fabrication and/or erection details indicated on the Contract Drawings. The Work shall be performed to meet actual field conditions encountered.

B. Preparation

1. The Contractor shall examine the areas and conditions under which the Work of this Section is to be performed. Conditions detrimental to the proper and timely completion of the Work shall be corrected. Work shall not be proceeded until unsatisfactory conditions have been corrected.

2. All new placement of concrete shall be in accordance with Section 03 30 00 – Cast-In-Place Concrete.

3. Concrete shall not be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

4. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

5. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

6. All joints shall be sealed as shown on the Contract Drawings.

C. Not Used

3.02 IMPLEMENTATION

A. General:

1. Materials shall be protected before, during and after installation to ensure acceptable finished Work. In-place materials and other operations of Work in connection with the joint installations shall be protected.

2. The Contractor shall install joint material per the construction schedule submitted to and approved by the Engineer in a sequence and manner that will not damage the Work.

3. In the event of damage to the Work, necessary repairs or replacements shall be performed until satisfactory Work is met at no expense to DEP.

B. Construction Joints

1. Contractor shall submit description of all joints and their location to the Engineer for approval, in accordance with this Section. Construction joints shall be as shown on the Contract Drawings where joints are indicated.

2. Unless noted otherwise on the Contract Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless

a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on the Contract Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

3. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0" unless otherwise indicated on the Contract Drawings.

4. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five (5) feet from a corner.

5. Waterstop shall be provided at all joints in water retaining structures. Waterstop shall be provided at all joints below grade in walls or slabs which enclose an accessible area.

6. All reinforcing steel and welded wire fabric shall be continued across joints. Inclined dowels shall be provided as detailed or directed by the Engineer.

7. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed. Following methods are acceptable:

   a. The use of an approved chemical retarder applied in accordance with the manufacturer's recommendations which delays but does not prevent the setting of the surface mortar. Retarded mortar shall be removed within twenty-four (24) hours after placing to produce a clean exposed aggregate bonding surface.

   b. By roughening the surface of the concrete in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

8. All construction joints shall be bonded by one of the following methods:

   a. The use of an approved adhesive applied in accordance with the manufacturer's recommendations.

   b. Use of Portland cement grout of similar proportions to the mortar in the concrete in an acceptable manner.

C. Control Joints

1. Location of control joints shall be as shown on the Contract Drawings or as allowed by the approved joint location submittals.

2. Control joints shall be formed with control joint inserts.

3. Sawcutting of control joints in lieu of forming shall not be allowed unless otherwise noted on the Contract Drawings. Where sawcutting is allowed, joints shall be sawed as soon as the concrete can support foot traffic without

leaving any impression, normally the same day as concrete is placed and in no case longer than twenty-four (24) hours after concrete is placed.

4. Unless noted otherwise on the Contract Drawings, depth of control joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

D. Expansion Joints

1. Size and location of expansion joints shall be as shown on the Contract Drawings.

2. A center-bulb type waterstop shall be provided at all expansion joints in water-retaining structures. A center-bulb type waterstop shall be provided at all expansion joints below grade in walls or slabs which enclose an accessible area. Waterstop shall be as shown on the Contract Drawings and specified herein.

3. Expansion joint filler for use in concrete pavements and structures shall be Types I, II, or III. Expansion joint filler-for use in sidewalk and curbing shall be Type IV.

4. Reinforcement or other embedded items bonded to the concrete (except dowels in floors bonded on only one side of joint) shall not be permitted to extend continuously through any expansion joint.

E. Installation of Joints and Joint Filter

1. Type B joint sealant shall be used in all expansion and control joints in concrete except Type A joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and Type C joint sealant shall be used in high corrosive areas unless otherwise specified or shown on the Contract Drawings.

2. Joint fillers and sealants shall be installed in accordance with manufacturer’s recommended procedures and as shown on the Contract Drawings. Prior to sealant installation, the Contractor shall arrange to have a representative of the sealant manufacturer instruct the crew doing the work as to the proper methods of surface preparation, mixing and application of the sealant. The joint filler shall be furnished with a pressure sensitive adhesive or a separate adhesive as recommended by the manufacturer.

3. Joint filler that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The filler shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

4. A bond breaker of polyethylene film shall be used between filler and sealant. The joint shall be thoroughly clean and free from dirt and debris and shall receive a light sand blasting before the primer and the sealant are

applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration.

5. The primer and sealant used shall be supplied by the same manufacturer. Sealant shall not be placed without the use of a primer.

6. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

7. The depth of the sealant shall not exceed the width of the joint.

8. All sealants used in water retaining structures shall achieve final cure at least seven (7) days before the structure is filled with water.

F. PVC Waterstops

1. The design and location of PVC waterstops in construction joints and expansion joints shall be as specified herein and shown on the Contract Drawings. Splices in PVC waterstops shall be made, and molded pieces used, as recommended by the manufacturer.

2. Each piece of premolded PVC waterstop shall be of maximum practicable length in order that the number of end joints will be held to a minimum.

3. Joints shall develop effective watertightness fully equal to that of the continuous PVC waterstop material and shall permanently develop not less than eighty (80) percent of the mechanical strength of the parent section and shall permanently retain its flexibility.

4. PVC waterstops shall be installed in the Work so that they are embedded to an equal depth in concrete on both sides of the joint in keyways as shown on the Contract Drawings and shall be kept free from oil, grease, mortar or other foreign matter. PVC waterstops shall be adequately secured against movement during the pouring of concrete. Contractor shall submit methods of PVC waterstop installation to the Engineer for approval prior to placing the concrete. Concrete adjacent to PVC waterstops shall be placed in twelve (12)-inch lifts and power vibrated to prevent honeycombing, voids and separation of aggregates at the surfaces of concrete separation joints.

   a. PVC waterstop fabrications for all changes of direction, intersections and transitions shall be made in the shop, leaving only straight butt joint splices for the field.

   b. Butt joint splices of PVC waterstop runs shall be made by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations using a thermostatically controlled electric source of heat. At least three (3) satisfactory field splices shall be made as samples on Site. The Engineer may require tests on these splices by an approved laboratory, at the Contractor's expense, to certify the tensile strength of the joint. The strength attained shall be at least eighty (80) percent of the unspliced material before any is used in the Work.

G. Hydrophilic Waterstop

1. Hydrophilic rubber waterstop or sealant shall be installed in accordance with the manufacturer's instructions and recommendations, except as modified herein.

2. The manufacturer shall provide technical assistance in the field.

3. The waterstop or sealant shall be located as near as possible to the center of the joint and shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be three (3) inches.

4. Where a hydrophilic rubber waterstop is used in combination with PVC waterstop, the hydrophilic rubber waterstop shall overlap the PVC waterstop for a minimum of 6 inches. The contact surface between the hydrophilic rubber waterstop, and the PVC waterstop shall be filled with hydrophilic sealant.

5. The hydrophilic rubber waterstop shall be installed in a bed of hydrophilic sealant, before skinning and curing begins, so that any irregularities in the concrete surface are completely filled and the waterstop is bonded to the sealant. After the sealant has cured, concrete nails, with washers of a diameter equal to the waterstop width shall be placed to secure the waterstop to the concrete at a maximum spacing of eighteen (18) inches.

6. Prior to installation of hydrophilic sealant, the concrete surface shall be wire brushed or sand blasted to remove any laitance or other materials that may interfere with the bonding. Surfaces of metal or PVC to receive sealant shall be cleaned of paint and any material that may interfere with bond. When sealant alone is shown on the Contract Documents, it shall be placed in a built-up bead which has a triangle cross section with each side of the triangle at least 3/4 inch in length, unless indicated otherwise. Concrete shall not be placed until the sealant has cured in accordance with the manufacturer's recommendations.

H. Injection Hose Waterstop

1. The injection hose shall be installed in maximum lengths of forty (40) feet and shall be located as shown on the Contract Drawings. The hose shall be clamped into position with anchor clips spaced approximately six (6) to ten (10) inches apart.

2. The concrete surface shall be cleaned of stones and debris prior to installation of injection hose. The injection hose shall be installed in direct contact with the face of concrete at the construction joint to prevent floating of the hose in the freshly placed concrete.

3. Where injection hose is used in combination with PVC waterstop, the hose shall overlap the PVC waterstop for a minimum of 6 inches and shall be less than two (2) inches away from the PVC.

4. The injection procedure shall be performed in strict conformance with the manufacturer's recommendations. The injection shall be made by an authorized applicator as recommended by the injection system supplier.

5. The injection system supplier or his approved representative shall provide the necessary supervision to satisfy the Engineer that the application conforms strictly to the manufacturer's recommendations.

6. The injector hose and opposite hose vent for each hose length shall be terminated in the injection boxes mounted on the dry side of the wall. At the end of the injection operation, the hose shall be cleaned in accordance with the procedure recommended by the manufacturer. The injection ends and the vents shall be plugged and the box covered leaving the system ready for reinjection in the event that the joint is leaking.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. PROTECTION

1. Joints and accessories shall be protected from damaging from traffic during the entire construction period. Waterstops provided for adjoining future structures shall be protected from corrosion as shown on the Contract Drawings.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and as shown on the Contract Drawings.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Implementation	6
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 – Sustainability Certification Project Requirements

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration

that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards:

1. New York City Building Code
2. ACI 301 - Specifications for Structural Concrete for Buildings
3. ACI 302.1R - Guide for Concrete Floor & Slab Construction
4. ACI 303R - Guide to Cast-in-Place Architectural Concrete Practice
5. ACI 308.1 - Specification for Curing Concrete
6. ACI 318 - Building Code Requirements for Structural Concrete
7. ACI 303R - Guide to Cast-in-Place Architectural Concrete Practice
8. ACI 347R - Guide to Formwork for Concrete
9. ISO 14025 - Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Erect, on the Site where directed, a full-size mock-up of a cast-in-place wall or panel a minimum of four (4) feet high, four (4) feet from the corner on two (2) sides, twelve (12) inches thick or as shown in the Contract Drawings conforming to ACI 303R.

1. Reinforce the panel as shown in the Contract Drawings. Use form ties the same as those approved and with the form tie pattern similar to that approved. Use one face for the panel for smooth architectural concrete including “reveal” rustication with form joints, and the opposite face for form liner concrete.
2. Plug the tie holes as specified to determine the correct mortar mixture to match the panel color. If required, remove and replace tie hole plugging mortar until an acceptable color match is obtained. After the sample panels have been approved, intentionally damage and patch portions of the finish surface of the panels for the purpose of determining the correct mixture for patching mortar and patching technique to match the original panel color and surface.
3. Leave the approved mock-up on the job during construction as the standard of workmanship for the Project. Remove mock-up form the premises after completion of the Work.

B. Perform work in accordance with ACI 301, ACI 302.1R, ACI 308.1, ACI 318 and ACI 347R and other applicable codes.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Material certifications and technical data sheets.

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of material used in the Work.

B. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor’s approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor’s New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Failure to comply with the following shall be sufficient cause for rejection of materials by the Engineer and his requiring its removal from the Site. Upon determination by the Engineer that the material is subject to rejection, the Contractor shall supply new material at no additional expense to DEP.

B. Delivery of Materials:

1. Deliver materials in manufacturer's original unopened and undamaged containers, with all labels intact and legible at the time of use.

2. The label shall include:

a. Name of material and manufacturer.

b. Installation, handling and protection requirements.

c. Safety Data Sheet as required.

3. Deliver materials in sufficient quantities to allow uninterrupted continuity of the work, minimizing the amount of time stored prior to being used on the Site.

C. Storage of Materials:

1. Store only approved materials on project site.

2. Store materials in original, undamaged containers with manufacturer's labels and seals intact.

3. Store all materials in secure, enclosed, dry area, off the ground and away from all possible contact with water and in a location where temperature can be maintained above freezing. Protect stored materials as per manufacturer’s instructions.

4. Prevent damage to materials during storage primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction Systems.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Concrete Floor Sealer

1. Floor sealer shall be:

a. MasterTop TC 493 330 as manufactured by Master Builders Solutions by BASF, Florham Park, NJ;

b. Superior Diamond Clear VOX as manufactured by Euclid Chemical, Cleveland, OH;

c. ArmorSeal Rexthane I as manufactured by Sherwin Williams,

d. Masterseal 330 as manufactured by Master Builders Solutions, Shakopee, MN.

e. Eucothane as manufactured by Euclid Chemical, East Brunswick, NJ.

f. SikaTop Seal 107 for exposed concrete, as manufactured by Sika Corporation, Lyndhurst, NJ.

g. Or approved equal.

B. Concrete Floor Hardener

1. Liquid Floor hardener shall be:

a. MasterKure 300 WB (Lapidolith) as manufactured by BASF, Florham Park, NJ;

b. Liquid Hard as manufactured by W.R. Meadows, Hampshire, IL;

c. Diamond Hard as manufactured by Euclid Chemical Company, Cleveland, OH;

d. Or approved equal.

2. Aggregate floor hardener shall be:

a. MasterTop 110ABR as manufactured by Master Builders Solutions, Shakopee, MN;

b. Surflex as manufactured by Euclid Chemical, East Brunswick, NJ.

c. Or approved equal.

C. Non-Slip Shake-On Aggregate and abrasion resistant floor hardener:

1. Non-slip abrasion resistant floor hardener shall be:

a. Duraltex 1805 with Duraltex 1807 or broadcast silica sand as manufactured by Euclid Chemical Company, Cleveland, OH;

b. Amorseal 8100 with Armorseal Hi-Wear Additive as manufactured by Sherwin Williams, Cleveland, OH;

c. Or approved equal.

2. Non-slip shake-on aggregate shall be:

a. MasterTop 120 SR (formerly Frictex NS) as manufactured by Master Builders Solutions by BASF, Florham Park, NJ;

b. Sikafloor 2 Syn Top as manufactured by Sika, Lyndhurst, NJ;

c. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Concrete Floor Sealer:

1. Sealer shall be aliphatic urethane or epoxy coating with resistance to abrasion and chemical attack.

B. Concrete Floor Hardener

1. Liquid Floor hardener product and manufacturer shall be as specified in this Section.
2. Aggregate floor hardener product and manufacturer shall be non-metallic and shall be as specified in this Section.

C. Non-Slip and Abrasion Resistant Floor Hardener:

1. Non-slip abrasion resistant floor hardener for application for new concrete to harden and provide a non-slip walking surface, even when wet. The floor System shall contain flakes or broadcast 20/40 mesh silica sand for traction.
2. Shake-on aggregate floor hardener designed for application to freshly cast concrete to harden and densify the surface for resistance to wear and abrasion.
    a. Product shall be a non-slip and non-rusting aggregate.
    b. Non-slip aggregate shall NOT be permitted if the base concrete mix design uses air entraining agents (exceeds 3%), fly ash, slag, fibers, water reducers, accelerators or retarders. These admixtures severely diminish and slow the availability of bleed water.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine substrates, areas, and conditions where concrete finishing products will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Prepare cementitious substrates according to manufacturer's published installation instructions prior to application of concrete finishing products.

3.02 IMPLEMENTATION

A. Finishes on Formed Concrete Surfaces

1. After removal of forms, the finishes described below shall be applied in accordance with – "Concrete Finish Schedule" included in this Section. Unless specified in the Contract, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish Work.

a. Type I - Rough or Board Form Finish: All fins, burrs and other projections left by the forms shall be removed. All holes left by removal of ties, and all other holes, depressions, or voids shall be filled solid with cement grout after first being thoroughly wetted. Honeycombs shall be chipped back to solid concrete as directed, prior to patching with cement grout. Holes shall be filled with a small tool that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface. The surface shall be thoroughly cleaned of all stains or discolorations that will interfere with the final finish.

b. Type II - Smooth Form Finish: Concrete shall be cast against forms constructed of plywood not less than 5/8 inch thick, or of boards lined with tempered hardboard not less than 3/16 inch thick, or other approved materials. Form material shall not have torn grain, worn edges, patches of holes from previous use, or other defects which would impair the texture of the concrete surface. Form material shall utilize sheets as large as practicable in an orderly and symmetric configuration. Other aspects of the finish shall conform to the requirements of the rough form finish.

c. Type III - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type II finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 30 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats and scrubbed into the surface using a rotary motion. Any surplus material shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.

d. Type IV - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish no later than one day following form removal. Nor rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted.

e. Type V - Textured: Use textured forms or textured form liners of plastic, wood, or sheet metal. Secure liner panels in forms by cementing or stapling, not by methods which will permit impressions of nail heads, screw heads, washers, or the like to be imparted to the surface of the concrete. Seal edges of textured panels to each other or to divider strips to prevent bleeding of cement paste. Use a sealant that will not stain the concrete surface.

f. Type VI - Aggregate transfer: Produce aggregate transfer and other special finished that duplicate mock-ups or sample panels prepared in advance and accepted.

g. Type VII - Exposed Aggregate: Expose aggregate using one of the following methods. Provide a concrete surface that will duplicate a mock-up or a sample panel prepared in advance and accepted.

1) For a scrubbed finish, cast concrete against form faces which have been coated with a chemical retarder used in accordance with the manufacturer's recommendations. Wet the partially hardened concrete surface thoroughly and scrub with fiber or wire brushes, using water freely until the surface mortar is removed and the aggregate is uniformly exposed. Then rinse the surface with clear water. If portions of the surface have become too hard to permit uniform aggregate exposure, use dilute hydrochloric acid (one part commercial muriatic acid diluted with 4 to 10 parts water) to remove the excess surface mortar after the concrete is at least 2 weeks old. Remove the acid from the finished surface with clean water within 15 minutes after application.

2) For a blast finish, sandblast or waterblast the concrete surface to a degree sufficient to expose fine aggregates with occasional exposure of coarse aggregate, and to produce a uniform color with a maximum reveal of 1/16 inch unless specified otherwise in the Contract Documents. All surfaces with the same specified blast finish shall be done at approximately the same time after placing co concrete. Use stainless steel or plastic reinforcement supports and spacers near concrete surfaces to be blasted. Protect adjacent materials and inserts during blasting operations.

3) For a tooled finish, dress the thoroughly cured concrete surface with electric, air, or hand tools to a uniform texture removing surface mortar as specified in the Contract Documents. Then provide the surface with a hand tooled, rough or fine pointed, crandalled, or bush-hammered surface texture, as specified by Contract Documents.

h. Type VIII - Applied: When finishes of stucco, cementitious coatings, or similar troweled materials are required or permitted, prepare the surface of the concrete to ensure permanent adhesion of the finish. If the concrete is less than twenty-four (24) hours old, roughen it with a heavy wire brush or scoring too. If the concrete is older, roughen the surface mechanically or by acid etching. After roughening, wash the surface free of all dust, acid, chemical retarder, and other foreign material before any final finish is applied.

B. Slab and Floor Finishes

1. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with – "Concrete Finish Schedule" included in this Section. The Engineer shall be the sole judge of acceptability of all such finish Work.

a. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required.

b. Type "B" - Scratched: Following completion of Type "A" finish, roughen the surface with stiff brushes or rakes before final set.

c. Type "C" - Floated: Following completion of Type "A" finish, do not work the concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disc float as soon as the water sheen had disappeared and the surface has stiffened sufficiently to permit the operation. During or after the first floating, check flatness of surface with a 10 ft straightedge applied in two or more directions. Eliminate high spots and low spots during this procedure to produce a conventional, straight edge finish, then refloat the slab immediately to a uniform texture.

d. Type "D" - Troweled: Following completion of a Type "C" finish and sufficient hardening of the concrete to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with a power trowel. Following the power trowel, hand trowel to provide a smooth, dense surface, free from defects, trowel marks, and blemishes. For surfaces exposed to wear as indicated in the Contract Documents, continue hand troweling until a ringing sound is produced as the floor is troweled.

e. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "C" finish.

f. Type "F" - Liquid Hardened Finish: Liquid hardened finish shall be provided by application of a liquid floor hardener. Floors to receive this finish shall have previously received a Type "D" finish. Liquid

hardener shall be applied between 30 to 60 days after concrete placement. Surface to be treated shall be dry, clean and free of all loose dust, dirt, oil, wax, sealers and curing compounds. Application procedure shall be in accordance with manufacturer's instructions and shall consist of a three-coat treatment.

g. Type “G” - Dry Shake Hardened Finish: Aggregate hardened finish shall be provided by applying an aggregate floor hardener concurrently with the application of a Type “D” finish. Application procedure shall be in accordance with manufacturer's instructions.

h. Type “H” - Non-Slip Finish: This finish shall be provided by applying a non-slip shake-on aggregate concurrently with the application of a Type “D” finish. Application procedure shall be in accordance with manufacturer's instructions.

C. Sealing of Concrete Floor

1. After installation of all equipment and piping, and after completion of other related construction activities, all floor slabs which are to remain unpainted and not intended to be immersed, and all equipment pads, shall be sealed with a floor sealer unless the slab has had liquid hardener applied or stated otherwise. Remove all dirt, droppage, grease, asphalt or other foreign matter with caustics and detergents as required prior to application. Sealer shall be applied in accordance with the manufacturer's recommendations.

D. Finishes on Equipment Pads

1. Formed surfaces of equipment pads shall receive a Type II finish.

2. Top surfaces of equipment pads, except those surfaces subsequently required to receive non-shrink grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive non-shrink grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

E. Concrete Finish Schedule

Item	Finish Type
All concrete surfaces not exposed to public view including utility spaces	I
All exterior surfaces and interior vertical surfaces exposed to public view	IV
All interior overhead surfaces exposed to public view and interior walls of tanks	II
Surfaces to be painted	III

Item	Finish Type
Architectural finish	V, VI, VII, or VIII as indicated in the contract documents
Surfaces to receive bonded cementitious mixtures	B
Drives, interior stairs, surfaces to receive waterproofing, roofing insulation, or terrazzo, and floors of tanks	C
Floors for walking surfaces in manufacturing, storage, and warehousing areas, and floors to receive coverings	D
Sidewalks	E
Garage and storage area floors	F or G
Exterior stairs, platforms, landings and ramps and interior ramps	E or H

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 03 35 16 – HEAVY-DUTY CONCRETE FLOOR FINISHING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes systems of multi-component heavy-duty concrete topping consisting of epoxy and vinyl ester resins, curing agents, aggregates and inorganic pigments.

B. All Systems include scarification, acid etching and other substrate preparations, bond coats, reinforcements, underlayment fills, binder coats, top coats and other components and system accessories recommended by the manufacturer for cast-in-place concrete floor slabs, curbs, equipment pads, tops and sides of containment dike walls, trenches, steps, sumps, equipment pits and similar cast-in-place concrete items which may be subject to heavy traffic and aggressive chemicals, including manufacturer's recommended details for conditions encountered in the Work and a Field Quality Control Report including procedures, test methods, results of tests, remedial recommendations and actions.

C. Provide complete technical services as available from the specified manufacturer and on-Site technical representation by manufacturer's Technical Representative during the time of material delivery, storage, job mock-up, substrate preparation and the advancement of installation to thirty percent of floor areas receiving concrete topping and during the start of field quality control testing.

D. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, and place into satisfactory service all concrete topping Work.

E. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements for the work of this Section are implemented to the fullest extent.

F. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	5
1.07	Submittals	8
1.08	Delivery, Storage, and Handling	11
1.09	Spare Parts, Special Tools, and Supplies	12
1.10	Warranty	12
PART 2	PRODUCTS	13
2.01	Manufacturers	13
2.02	Materials / Equipment	13

2.03 Fabrication / Assembling / Finishes 14
2.04 Source Quality Control / Shop Tests 14
PART 3 EXECUTION.....15
3.01 Examination / Preparation 15
3.02 Installation.....15
3.03 Field Testing / Quality Control 16
3.04 Startup / Demonstration 17
3.05 Adjusting / Protection / Cleanup.....17

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 – Sustainablity Certification Project Requirements

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1. NYCBC - New York City Building Code
2. ASTM C109 - Compressive Strength of Hydraulic Cement Mortars, Standard Test Method for
3. ASTM C150 - Portland Cement, Standard Test Method for
4. ASTM C321 - Bond Strength of Chemical-Resistant Mortars, Standard Test Method for
5. ASTM C413 - Absorption of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing's, and Polymer Concretes Standard Test Method for
6. ASTM C501 - Relative Resistance to Wear of Unglazed Ceramic Tile By the Taber Abraser, Standard Test Method for
7. ASTM C531 - Linear Shrinkage and Coefficient of Thermal

			Expansion Of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing's, and Polymer Concretes, Standard Test Method for
8.	ASTM C580	-	Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing's and Polymer Concretes, Standard Test Method for
9.	ASTM D635	-	Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position, Standard Test Method for
10.	ASTM D638	-	Tensile Properties of Plastics, Standard Test Method for
11.	ASTM D696	-	Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C and 30 Degrees C with a Vitreous Silica Dilatometer, Standard Test Method for
12.	ASTM D790	-	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, Standard Test Method for
13.	ASTM D1044	-	Resistance of Transparent Plastics to Surface Abrasion, Standard Test Method for
14.	ASTM D1308	-	Effect of Household Chemicals on Clear and Pigmented Organic Finishes, Standard Test Method for
15.	ASTM D2047	-	Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine, Standard Test Method for
16.	ASTM D2240	-	Rubber Property - Durometer Hardness, Standard Test Method for
17.	ASTM D4060	-	Abrasion Resistance of Organic Coatings by the Taber Abraser, Standard Test Method for
18.	ASTM E84	-	Surface Burning Characteristics of Building Materials, Standard Test Method for
19.	ASTM E831	-	Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis, Standard Test Method for
20.	ISO 14025	-	Environmental labels and declarations - Type III

environmental declarations

21. MIL-D-3134J - Military Specifications, (Navy) Deck Covering Materials

22. South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings.

1.05 DESCRIPTION

A. Sustainable Design Requirements

1. VOC Content: Products applied on site and within the building's weatherproofing system shall comply with VOC limits of authorities having jurisdiction and the following VOC limits of when calculated according to SCAQMD Rule 1113:

a. Industrial Maintenance Coatings (i.e. Concrete Topping): VOC not more than 100 g/L.

b. Primers, Sealers, and Under-coaters: VOC not more than 100 g/L.

B. Environmental Conditions:

1. Contractor to remove all chemicals, compounds and other materials from substrates when such materials are unacceptable to the manufacturers of concrete topping systems specified at no additional expense to DEP.

2. Proceed with concrete topping work only when temperature and moisture content of concrete slabs, building air temperature, relative humidity and other conditions comply with the concrete topping manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the materials will be subject to such environmental damage.

3. Maintain substrate temperature and room temperature before, during and after installation above fifty (50) degrees Fahrenheit and rising in accordance with concrete topping material manufacturer's instructions. Provide adequate ventilation during application and curing periods.

4. Do not begin concrete topping work until buildings are enclosed and manufacturer's recommended environmental conditions can be maintained and only when manufacturer and installer are willing to guarantee the Work as required and without additional reservations and restrictions.

5. Site Facilities: Supplemental heat sources as may be required should Contractor wish to continue concrete topping work in cold weather is not available at the Project Site. Provision of all supplemental heat, energy sources and equipment is the exclusive responsibility of Contractor, as is the requirement that the source of supplemental heat shall not emit contaminants which will adversely affect the color, cure or performance of the concrete topping. Concrete topping systems so affected shall be removed and replaced with new at no additional expense to DEP.

6. Record decisions, conditions and agreements to proceed with the Work when environmental conditions might be unfavorable. State the reasons for proceeding, with the names of the persons involved along with the changes, if any, or revisions, requirements or terms of the Contract. Include all information in final Field Quality Control Report.

C. Scheduling and Coordination:

1. Review installation procedures under this and other related specification and or Contracts and coordinate them with the Work specified herein.

2. Notify other Contractors in advance of the installation of Work to provide them with sufficient time for installation and coordination of interrelated items that are included in their contracts and that must be installed in conjunction with the concrete topping work.

3. Proceed with the concrete topping and associated work after projections and penetrations through the substrates have been installed, and when the substrate construction and framing of openings is complete.

4. Coordinate and schedule scarification, grinding and filling of cast-in-place concrete with cementitious underlayment's, in order to bring substrate within tolerances specified, and abrasive blasting of substrates and installation of concrete topping before equipment and similar items are installed to avoid later difficulty or delay in performing the concrete topping work. In order to advance the work be prepared to schedule multiple visits of the concrete topping installer to the Project Site for the purpose of installing concrete topping in areas that will become inaccessible with the installation of other Work as may be required for proper sequencing of the Work.

5. Coordinate required thickness of cementitious underlayment's with doors, thresholds, piping and equipment, adjacent materials and similar items in order to provide smoothly aligned transitions acceptable to Engineer and in compliance with governing authorities.

D. Substitutions:

1. Do not change products, system components, colors or manufacturers after Shop Drawing and Samples approvals by Engineer.

Clearly identify, in a manner which is highlighted to Engineer, all proposed substitutions, modifications, variations, unspecified features and "or approved equal" products. Provide complete comparative data with specified products at time of Shop Drawing submission.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer skilled, trained and with successful experience in the application of each product who is an approved applicator of the manufacturer, or who can submit evidence in writing of being acceptable to

the manufacturer for production of guaranteed construction and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owners, architects or engineers responsible for projects.

b. Approximate contract cost of the concrete topping.

c. Amount of area installed.

2. Submit proof of acceptability of installer by manufacturer to Engineer.

B. Performance Criteria:

1. Contractor's Review: Accompanying approval request, submit to Engineer a written statement signed by Contractor, stating that the Contract Drawings and Contract Specifications have been reviewed with an agent of the concrete topping material manufacturer and that he is in agreement that the selected systems are proper, compatible and that the details used for the work are not in conflict with the manufacturer's details.

2. Statement of Application: Upon completion of the concrete topping work, submit a notarized statement to Engineer signed by Contractor stating that the work complies with the requirements of these Sections, was installed in compliance with manufacturer’s written recommendations and that the installation methods were proper and adequate for the conditions of installation and use.

C. Allowable Installation Tolerances:

1. Do not install Work until substrate preparation and tolerances have been approved by Engineer, concrete topping manufacturer’s Technical Representative and the concrete topping installer and Contractor has verified to Engineer that substrates are within tolerances specified and acceptable to produce approved Work. Work advanced for any reason without such verification shall be stopped, removed and replaced with new material after substrate is approved, at no additional expense to DEP.

2. Substrate Tolerances:

a. Out-of-Plane: 1/8 inch maximum in 10 foot - 0 inches and 1/16 inch maximum in any 12 inches measured along the plane.

b. Maximum Offset in Plane Alignment: 1/16 inch.

c. Variation From Slope: 1/8 inch maximum in 10 foot - 0 inches.

3. Concrete Topping Tolerances:

a. Finished concrete topping level to 1/8 inch in 10 feet - 0 inches with smooth continuous uniformly sloped-to-drain planes.

b. Provide smooth continuous color with no color streaks or inconsistencies with smoothly textured non-slip finish.

D. Requirements of Regulatory Agencies:

1. Materials and equipment submitted for DEP's approval by the Contractor shall have met, at the time of their submittal, the certification and material acceptance requirements of the NYC Department of Buildings, unless otherwise required by the Authority Having Jurisdiction over the Work.

2. All material provided under this Section shall comply with the Contract.

3. Comply with all applicable requirements of governing authorities and codes for all Work.

E. Testing Agency: Engage a testing laboratory regularly engaged in the testing of construction materials, and who complies with ASTM E329.

F. Pre-installation Meeting:

1. Before erecting job mock-up, Contractor, his concrete topping installer, and Technical Representative of the concrete topping system manufacturer shall meet on-Site with Engineer to discuss approved products and workmanship to ensure proper application of concrete topping system components and substrate preparation requirements for the Work.

2. Record the discussions of the conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending. Review foreseeable methods and procedures related to the concrete topping Work, including, but not necessarily limited to, the following:

a. Review project requirements (Drawings, Sections and other Contract Documents).

b. Review required submittals, both completed and yet to be completed.

c. Review status of substrate work, including approval of surface preparations, drying, structural loading limitations and similar considerations.

d. Review requirements of field quality control testing and requirements for preparing field quality control report as specified herein.

e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

f. Review required inspection, testing and certifying.

g. Review environmental conditions, other job conditions, and procedures for coping with unfavorable conditions.

h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.

i. Review procedures needed for protection of concrete topping during the remainder of the construction period.

3. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

4. Record any revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.

G. Job Mock-Up:

1. Prior to the installation of concrete topping systems, but after Engineer's approval of Shop Drawings submittals, erect stepped-back job mock-ups using substrate preparation, materials and application techniques specified for final work. Provide all components of the concrete topping systems showing the correct installation, substrate preparation and the workmanship quality which shall be achieved in the work. Build mock-ups at the Site, in location approved by Engineer, of full thickness and approximately twelve (12) foot - zero (0) inches square. Indicate the proposed workmanship to be expected in the finished Work. Include methods of installation typical to the Work including penetrations, crack and joint sealer system and cove details using all system components required for the Work. Obtain Engineer's acceptance of mock-up before start of Work. Retain and protect mock-up before start of Work. Retain and protect mock-up during construction as a standard of judging completed Work. Do not alter or destroy mock-up until given written permission by Engineer.

2. Build as many job mock-ups as necessary in order to achieve Engineer's acceptance of the Work.

H. Concrete topping work which proceeds without an approved job mock-up shall be stopped, removed and re-installed, after job mock-up approval, at no additional expense to DEP.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Samples: Submit for approval the following:

a. Stepped-back concrete topping system applied to a twelve (12)-inch by twelve (12)-inch by two (2)-inch thick concrete sample showing each system component and demonstrating required surface preparation to be used on job mock-up and required thickness of concrete topping. Apply concrete topping to only one-half of the sample board, leaving the other half visible and with required substrate preparation.

b. Full selection of manufacturer's standard and custom colors for selection by Engineer. Engineer will preliminarily select a maximum of twelve (12) colors for consideration for use in the Work.

c. Prepare twelve (12)-inch by twelve (12)-inch samples of each color. From these Engineer will select a maximum of eight colors to be used in the work. Engineer will provided Contractor with locations of each color after this final selection.

d. In addition to color, provide range of textures from smooth to heavily non-slip for selection for use on job mock-up panel.

e. Samples will be reviewed by Engineer for color selection, general appearance and as examples of the types of components to be installed on the job mock-ups.

f. Compliance with other requirements is the responsibility of Contractor.

2. Shop Drawings: All products, systems and installation recommendations submitted shall be subject to approval at the time of field quality control testing. Submit for preliminary approval the following:

a. Copies of specifications, technical information, test results, installation instructions and general recommendations from the concrete topping manufacturer, for each type of concrete topping product required. Include requirements for environmental conditions and other conditions required for an acceptable installation providing features and performance as stated in manufacturer's literature.

b. Drawings showing extent of each component of each system used in the Work including all items receiving concrete topping such as equipment pads, curbs, sumps, pipe trenches and similar items and surfaces and all details required for the Work referencing required system components provided as samples to Engineer. Provide Shop Drawings coordinated with cast-in-place concrete and showing all construction, and other conditions encountered in the Work and manufacturer's approved and recommended details appropriate to construction, expansion and seismic joints as required for full concrete topping system performance whether or not specific indication is made on the Contract Drawings to the details of the specified manufacturer.

c. Show interface details with other items such as thresholds, curbs, coves, equipment pads, expansion and seismic joint cover assemblies, floor hatches, heating registers, ramps, steps and stair nosing's.

d. Copies of Material Safety Data Sheets for all products used in the Work and copies of transmittals indicating receipt of MSDS by concrete topping systems installer.

e. Maintenance Manual: Upon completion of the Work, furnish copies of a detailed maintenance manual for each product, including the following information:

1) Product name and number.

2) Name, address and telephone number of manufacturer and local distributor.

3) Detailed procedures for routine maintenance and cleaning.

4) Detailed procedures for light repairs such as dents, scratches and staining.

5) Material Safety Data Sheets.

3. Test Reports: Submit for approval the following:

a. Copies of test reports verifying compliance with physical properties specified herein.

b. Copies of testing agencies background and experience in preforming similar tests to those specified.

c. Copies of final Field Quality Control Test Report as specified. Final payment for the concrete topping Work is contingent upon Engineer's approval of final Field Quality Control Report and recommendations for, and completion of, all remedial Work.

4. Certificates: Submit for approval the following:

a. Copies of certificates stating that the concrete topping systems installer has been approved, or is a licensee of the concrete topping manufacturer.

b. Evidence of installer's experience.

c. Evidence prior to delivery that materials and components furnished conform to the Sections and are as approved on Shop Drawings submittals.

d. Evidence of acceptance of the substrate by the concrete topping installer and manufacturer's Technical Representative.

5. Contractor's Review: Accompanying approval request, submit:

a. Specified statement to Engineer.

b. Show by copy of transmittal form that a copy of the statement has been transmitted to the manufacturer.

6. Statement of Application: Upon completion of the concrete topping Work, submit:

a. A notarized statement to Engineer as specified.

7. Field Quality Control Report, see Article 3.03 (Field Testing/Quality Control) for field quality control requirements.

B. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

3. VOC Reporting Form. Provide the following information:

a. For all concrete topping and sealer, applied on site and within the building's weatherproofing system, provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Failure to comply with the following shall be sufficient cause for rejection of materials by Engineer and removal of rejected materials from the Site. Supply new material at no additional expense to DEP.

B. Delivery of Materials:

1. Deliver materials in concrete topping manufacturer's original unopened and undamaged containers, with information accurately representing container contents as approved by Engineer at time of Shop Drawings submission.

2. Include the following information on the label:

a. Name of material and supplier.

b. Installation, handling and protection requirements.

3. Deliver materials in sufficient quantities to allow uninterrupted continuity of the Work.

C. Storage of Materials:

1. Store only approved materials on project site.
2. Store materials in original, undamaged containers with manufacturer's labels and seals intact.
3. Store all materials in a dry, enclosed area, off the ground and away from all possible contact with water and in a location where temperature can be constantly maintained between 60 F and 75 F and out of direct sunlight.
4. Prevent damage to materials during storage primarily by minimizing the amount of time they are stored at the job-site before being incorporated into construction systems.

D. Handling of Materials:

1. Do not handle, open or mix component materials unless concrete topping can be properly handled as recommended by the manufacturer of the concrete topping.
2. Do not open containers, or expose materials to detrimental conditions. Materials which are so exposed shall be removed from the site and shall not be incorporated into the work.
3. Handle materials carefully and in a manner which prevents contamination and inclusion of foreign materials.
4. Do not open packages or containers until all necessary preparatory work is complete, approved and installation will begin immediately.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall submit a two (2)-year bonded warranty for coverage after the expiration of the Maintenance and Guaranty period as set forth in Article 24.1 of the Standard Construction Contract. The warranty shall extend to all aspects of the Work, including, but not limited to, substrate preparation, materials and installation techniques. The warranty shall include the removal and reinstallation of concrete topping that shows signs of chemical or physical deterioration, delamination or improper installation. Such replacement shall be performed using materials and methods specified herein at no further cost to DEP. Concrete topping which fails due to abnormal use shall not be included under the guarantee. Such replacement shall occur within one (1) year after receipt of a written notice from DEP. The Contractor shall provide a letter from its surety company with bid confirming that they can furnish a two (2)-year bonded warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Heavy-Duty Concrete Topping

   a. STONCLAD HT with Clear STONKOTE HT4 Topcoat as manufactured by Stonhard Incorporated, Maple Shade Township, NJ.

   b. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Heavy-Duty Concrete Topping: Provide the following three (3)-component, troweled mortar flooring system consisting of a two (2)-component, penetrating, moisture tolerant epoxy primer, epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments, capable of, and recommended by the manufacturer for, resisting heavy duty trucking and heavy traffic.

1. Acid Etch: Provide manufacturer's recommended acid etching compound in addition to scarification and other required surface preparations.

2. Bond Coat: As recommended by the manufacturer.

3. Aggregate: Acid resistant granite chips.

4. Binder: Type I Portland cement, ASTM C 150, with additives.

5. Top Coats: Two (2)-component epoxy.

6. Termination Strips and Control Joints: White metal, neoprene filled type as recommended by the manufacturer.

7. Primer: Two (2)-component, penetrating, moisture-tolerant epoxy primer.

8. Colors: To be selected by Engineer from manufacturer's full selection of standard and custom colors.

9. Textures: Non-slip surface.

10. Physical Properties: The completed installation when thoroughly cured shall have the following physical properties:

    a. Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings, ASTM C 307: 2,250 psi.

    b. Standard Test Method for Tensile Properties of Organic Coatings,:ASTM D2370-16: Not less than 4,375 psi (30.2 MPa) tensile strength, 3.7% elongation and 2,778 psi (19.2 MPa) modulus of elasticity, average of 10 samples.

    c. Flexural Modulus of Elasticity, ASTM, C 580: 5,000 (psi) pounds per square inch.

    d. Indentation, MIL-D-3134: No indentation.

e. Bond Strength, ASTM C 321: 400 pounds per square inch minimum.

f. Flammability, ASTM D 635: Self-extinguishing.

g. Coefficient of Friction, ASTM D 2047: 0.6.

h. Resistance to Elevated Temperature, MIL-3134J: No Slip or flow.

i. Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis, ASTM E831 - 19: 2 x 10^{-6} inches per inch per F maximum, temperature range, -12 F to 140 F.

j. Abrasive Resistance, ASTM D-4060, CS-17

k. Flexural Strength Modulus of Elasticity, ASTM D 790: 1.5 x 10^{-6} pounds per square inch.

l. Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes, ASTM C 579: 11,500 pounds per square inch minimum.

m. Surface Hardness, ASTM D 2240: 87-90.

n. Water Absorption, ASTM C 413: 0.2 percent.

11. Sealer: Two-component, solvent-based coating formulated from a solid bisphenol A epoxy resin and a polyamide curing agent.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Source Quality Control:

1. Engage a single manufacturer who shall provide the services of a Technical Representative who shall assist Contractor, Engineer and DEP by providing technical opinions on the adequacy of materials and methods of installation and field quality control testing based on Shop Drawings approved by Engineer.

2. Provide such services during the time of delivery, storage, job mock-up construction, installation, and field quality control testing of all concrete topping components.

3. Provide a manufacturer who will provide complete technical services including preparation and review of Shop Drawings, installation methods and proposed detailing for the work. Where the manufacturer requires additions, or changes to the Contract Drawings and Contract Specifications these shall be made at no additional expense to DEP and only as acceptable to Engineer.

4. Provide only the highest quality materials, environmental features, and methods of construction and installation as recommended by the manufacturer and as acceptable to Engineer.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall examine the surfaces to receive concrete topping, and the conditions under which the trowel-applied concrete topping work is to be performed, and notify Engineer in writing of all conditions detrimental to the proper and timely completion of the Work and the performance of the concrete topping systems. Do not proceed with the concrete topping work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Substrate Preparation

1. Scarification and Acid Etching: All areas to receive the Work of this Section shall be given a heavily scarified finish to insure maximum topping adhesion followed by concrete topping manufacturer's recommended acid etching and neutralizing treatment. After acid neutralization, flush all surfaces with clean water.

2. Provide cast-in-place concrete slabs free from voids and sharp projections before placing any concrete topping system. Remove surface irregularities on cast-in-place concrete and fill all holes, honeycombs, spalls and cracks using manufacturer's recommended cementitious underlayment. Repair areas of unacceptable consolidation.

3. Fill or grind concrete substrate as may be required to achieve a uniform, level finished appearance on finished Work.

4. Prior to start of applying flooring, vacuum surfaces to be covered and inspect the subfloor.

5. Primer: Apply primer as recommended by concrete topping manufacturer, prior to application of the base coat. Apply in accordance with manufacturer's directions as approved by Engineer at time of Shop Drawing submission.

3.02 INSTALLATION

A. Do not power trowel concrete topping unless manufacturer provides written certification approved by Engineer that material shall experience no loss in compressive strength or tensile strength.

B. Apply termination and expansion joint strips at the junction of the flooring with other materials and at expansion joints as recommended by the manufacturer.

C. Mix materials and apply bonding coat in accordance with manufacturer's instructions.

D. Apply epoxy and vinyl ester mortar floor topping body coats to not less than 1/4-inch dry cured minimum thickness. Apply epoxy and vinyl ester mortar floor topping body coats of greater wet film thickness to compensate for any loss of volatile compounds during curing.

E. Apply glass reinforcement as specified.

F. Apply grout coats to smooth body coat.

G. Power sand to remove trowel marks.

H. Apply top coat sealer material for maximum chemical resistance as recommended by the manufacturers. Apply a final top coat, to match the texture of the approved job mock-up.

3.03 FIELD TESTING / QUALITY CONTROL

A. Before general installation of concrete topping work commences, perform the following field quality control tests and include procedures and results in final Field Quality Control Report. Incorporate installation or system improvements, as may be recommended based on test results, into the remainder of the Work at no additional expense to DEP.

1. Heavy-Duty Concrete Topping: Before commencement of installation, and after approval of job mock-up and substrate preparations, test heavy-duty concrete topping system for a period of one month by installing a two-hundred (200) square foot section within the plant in a location directed by Engineer. Installation shall be supervised and approved by manufacturer's Technical Representative as an acceptable installation. Subject this test area to the full range of wear which is likely to be seen in the finished Work. At the completion of test the flooring shall show no signs of delamination, premature wearing, deterioration in excess of manufacturer's approved test data, and no signs of cracking, crazing or color changes. If the test area demonstrates these features the concrete topping material shall be rejected by Engineer and another test may be performed at the expense of Contractor. If the heavy-duty concrete topping fails to perform according to Section at the completion of this second test, the heavy-duty concrete topping system shall be rejected and an "approved equal" product shall be submitted for approval by Contractor. Test "approved equal" product as specified herein.

2. At the end of the quality control test periods and before general installation commences, the installer, Contractor, Technical Representative and Engineer shall make final inspections of concrete topping systems and Contractor shall prepare a written report to Engineer describing all methods, observations, results and deterioration or damage found in the Work with recommendations for correcting such damage. Include photographic record of all test areas before, during and after the tests and photos of damages and physical changes in the concrete topping. The report shall contain all comments made by all parties, test results, and manufacturer's performance claims as preliminarily approved by Engineer at time of Shop Drawing

submittal as compared to the actual results of the field testing. Make changes to report as required by Engineer for approval of the work. Include quality control test report as part of final Field Quality Control Report.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection:

1. Protect materials against damage by construction activities.

2. Do not install concrete topping when adequate protection of the Work is not, or cannot, be made available.

3. Upon completion of the Work, the installer shall advise Contractor of recommended procedures for his surveillance and protection of the concrete topping work during the remainder of the construction period.

4. Do not allow construction traffic which is not associated with the installation of the concrete topping and related materials in the area of Work. Concrete topping shall be kept free of all traffic for a minimum of seventy-two (72) hours after completion of top coating. Protect installed concrete topping from damage, by use of heavy Kraft paper or other covering so that concrete topping is without damage, or unusual or accelerated wear at time of Final Acceptance.

5. Concrete topping damaged in any manner shall be replaced at no additional expense to DEP.

6. Only the installer shall replace deteriorated or defective Work found at the time of final inspection. The installer shall repair damages to the concrete topping work which occurred subsequent to concrete topping installation and prior to final inspection. Replace the Work so that there will be no question as to the condition of concrete topping and associated Work at the time of Final Acceptance.

B. Cleanup

1. After construction work is completed in the areas of concrete topping, and before Final Acceptance by DEP, clean all floors and other surfaces containing concrete topping using methods recommended by the concrete topping manufacturer.

2. The concrete topping at the time of Final Acceptance shall be clean and without damage, and shall not be soiled in any way. Vacuum and wet mop areas which become soiled after initial cleaning, up to the time of Final Acceptance by DEP.

END OF SECTION

SECTION 03 41 00 – PRECAST STRUCTURAL CONCRETE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Precast, prestressed structural concrete as specified herein shall include solid and hollow concrete planks, tees and double tees, concrete wall panels, concrete troughs, concrete removable slabs, prestressed, post-tensioned structural concrete members and all accessories necessary, including product design not shown on the Contract Drawings, and including design and testing of the concrete mix.

B. Precast, prestressed structural members shall be provided where shown on the Contract Drawings, specified herein or as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	8
1.09	Spare Parts, Special Tools, and Supplies	9
1.10	Warranty	9
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	12
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	13
3.01	Examination / Preparation	13
3.02	Implementation	13
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	16
3.05	Adjusting / Protection / Cleanup	16

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 - Sustainability Certification Project Requirements

B. Section 03 10 00 - Concrete Forming and Accessories

C. Section 03 21 00 - Reinforcing Steel

D. Section 03 30 00 - Cast-in-Place Concrete

E. Section 03 35 00 - Concrete Finishing

F. Section 03 60 00 - Grouting

G. Section 04 05 00 - Common Work Results for Masonry

1.04 REFERENCES

A. Definitions

1. Anchorage: A device used to anchor the tendon to the concrete member.
2. Bonded tendon: A prestressing tendon which is bonded to the concrete either directly or through grouting.
3. Coating: Material applied to unbonded tendons to protect them from corrosion; or material applied to either bonded or unbonded tendons to lubricate them during stressing.
4. Coupling: Any device designed to transfer the prestressing steel wires, bars or strands that comprise a tendon.
5. Element diameter: The diameter of the individual prestressing steel wires, bars, or strands that comprise a tendon.
6. Environmental Product Declaration: A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.
7. Prestressing steel: That element of a post-tensioning tendon which is elongated and anchored to provide the necessary permanent prestressing force.
8. Sheathing: An enclosure in which post-tensioned tendons are encased to prevent bonding during concrete placement, such as a paper plastic jacket for unbonded tendons, or metal conduit for bonded tendons.
9. Tendon: An assemblage of steel elements such as wire, bar, or strand, complete with anchorage or anchorage devices used to impart prestress to concrete when the assembly is tensioned.
10. Unbonded tendon: A tendon which is not bonded to the concrete.

B. Reference Standards:

1. ASTM A 36 - Carbon Structural Steel.
2. ASTM A 53 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3.	ASTM A 276	-	Stainless and Heat-Resisting Steel Bars and Shapes.
4.	ASTM A 325	-	Structural Bolts, Steel, Heat Treated, 120/105 ksi: Minimum Tensile Strength.
5.	ASTM A 416	-	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
6.	ASTM A 615/A	-	Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
7.	ASTM A 666	-	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Application.
8.	ASTM C 31	-	Making and Curing Concrete Test Specimens in the Field.
9.	ASTM C 33	-	Concrete Aggregates.
10.	ASTM C 109	-	Test Method for Compressive Strength of Hydraulic Cement Mortars.
11.	ASTM C 138	-	Test method for Unit Weight, Yield, and Air Content of Concrete.
12.	ASTM A 143	-	Test Methods for Slump of Hydraulic Cement Concrete.
13.	ASTM C 150	-	Portland Cement.
14.	ASTM C 185	-	Test Method for Air Content of Hydraulic Cement Mortar.
15.	ASTM C 191	-	Test Method for Tensile Strength of Hydraulic Cement Mortars.
16.	ASTM C 260	-	Air-Entraining Admixtures for Concrete.
17.	ASTM C 330	-	Lightweight Aggregates for Structural Concrete
18.	ASTM C 494	-	Chemical Admixtures for Concrete.
19.	ACI 318	-	Building Code Requirements for Reinforced Concrete.
20.	AWSD1.1 and D1.4	-	Structural Welding Codes - Steel Reinforcing Steel.
21.	AASHTO	-	AASHTO Standard Specifications for Highway Bridges.
22.	Building Code of DEP of New York.		
23.	ISO 14025	-	Environmental labels and declarations - Type III environmental declarations

24. PCI-MNL-116 - Precast and Prestressed Concrete Institute, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products".

25. PCI-MNL-120 - Precast and Prestressed Concrete Institute, “Manual for PCI Design Handbook”, latest edition.

1.05 DESCRIPTION

A. Performance Requirements

1. Load Calculations: Precast, prestressed units shall be detailed and fabricated to withstand loads as calculated in accordance with the Building Code of the City of New York, and erection forces except as shown on the Contract Drawings. Structural properties of the units shall be calculated in accordance with ACI 318.

2. Dimensions and Tolerances: Precast, prestressed units shall be fabricated to dimensional tolerances in accordance with PCI-MNL-120.

a. Units shall be designed to accommodate construction tolerances, deflection of building structural members and clearances of intended openings.

1.06 QUALITY ASSURANCE

A. A qualified precast, prestressed concrete manufacturer and erector shall meet the requirements of PCI-MNL-116.

1. All manufactured precast, prestressed concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast, prestressed concrete and site-cast units shall be free of defects, checks, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the Site. The Engineer shall have the option of rejecting any or all of the precast, prestressed work if it does not meet with the requirements specified herein or on the Contract Drawings. All rejected Work shall be replaced at no additional cost to DEP.

2. The precast, prestressed concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. In lieu of such certification, the manufacturer, at his expense, shall meet the following requirements:

a. Retain independent testing or consulting firm approved by the Engineer and/or City.

b. Perform basis of inspection in accordance with the requirements of PCI-MNL-116.

c. Precast, prestressed plant shall be inspected at two-week intervals during production and issue a report, certified by a registered engineer verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and PCI-MNL-116. If the report indicates to the contrary, the engineer, at the precaster's expense, will inspect and may reject any or all products produced during the period of non-compliance with the above requirements.

B. Plant production and engineering shall be under direct supervision and control of an engineer who possesses a minimum of five (5) years of experience in precast, prestressed concrete work.

C. A qualified welder shall meet the requirements of ANSI/AASHTO/AWS Structural Welding Code, D1.1.

D. Quality Assurance

1. Materials shall be tested in accordance with the following requirements. Detailed description of test procedures and apparatus, as well as test results shall be included in the report.

2. Assembly shall be tested in accordance with Paragraphs 1.06D.3 and 1.06D.4 below, on a third sample for tendons that are not bonded, two samples of each tendon size at least ten (10) feet in length and complete with standard production quality anchorages.

3. Prestressing steel sample shall be tested in accordance with the appropriate ASTM Specification of Paragraph 2.02C.1. Tendon assembly shall be tested with a method that will allow accurate determination of the yield strength, ultimate strength, and elongation of the specimen to ensure compliance with Paragraphs 2.02E, or 2.02H and 2.02J.

a. For unbonded tendons, a dynamic test shall be performed on a representative tendon assembly which shall withstand without failure 500,000 cycles from sixty (60) to sixty-six (66) and back to sixty (60) percent of its guaranteed minimum ultimate strength. A prototype tendon assembly may be used provided the assembly has not less than ten (10) percent of the full size tendon strength. Single element tendons using one strand, bar, or wire shall be tested as a complete tendon assembly. Systems utilizing multiple strands, wires, or bars may be tested using a prototype tendon with sufficient number of elements to duplicate the behavior of a full-sized tendon.

b. Grout shall be tested for strength and shrinkage in accordance with the requirements of Section 03 60 00 - Grouting.

4. Following tolerances shall be complied with:

a. The bearing surface between anchorage and concrete shall be concentric with the tendons and perpendicular to the intended direction of the tendon within ± one (1) degree.

b. Tendons, sheathing, and anchorage shall be placed within the tolerances of ACI 117 for reinforcement placement, distance between reinforcement, and concrete cover as noted on the Contract Drawings. These tolerances shall apply separately to both vertical and horizontal dimensions and may be different for each direction except that in slabs the horizontal tolerance shall not exceed one (1) inch in fifteen (15) ft of tendon length.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and reference materials for the approval of the Engineer. Submittals shall include, but not limited to: Submittals shall include, but not be limited to:

1. Placing Drawings for manufacture and erection of precast, prestressed concrete units and provide the following information in addition to that required by Sections 03 10 00 – Concrete Forming and Accessories 03 21 00 – Reinforcing Steel.
2. Unit shapes, including elevations and sections, member piece marks and dimensions.
3. Plans and elevations locating and defining all products furnished by the manufacturer.
4. Finishes.
5. Relationship to adjacent materials.
6. Reinforcement, joint and connection details.
7. Erection sequence and handling requirements.
8. The location of tendons and sheathing throughout their length.
9. Size, details, location, materials, and stress grade (where applicable) for all tendons and accessories.
10. Jack clearances, jacking procedures, stressing sequence, initial tensioning forces, gauge pressures, and tendon elongation.
11. Locations and type of lifting and erection inserts. Certified reports for lifting inserts indicating allowable design loads shall also be submitted.
12. All dead, live and applicable loads and design criteria. When design is not detailed on the Contract Drawings, drawings shall be stamped by a Licensed New York State Professional Engineer.
13. Location, dimensional tolerances, and details of anchorage devices that are embedded in or attached to structure or other construction.

14. Other items cast into units.

15. Handling procedures, plans and/or elevations showing precast, prestressed concrete unit location and sequence of erection and lifting for special conditions.

B. Preliminary Data - The following information shall be submitted:

1. Typical stress-strain curve of the prestressing steel.

2. Test results of ultimate strength, yield strength, elongation, and composition for all material not produced in accordance with an ASTM specification.

3. Structural design calculations by a New York State Professional Engineer.

4. Values of the wobble coefficient and the curvature coefficient, and anchorage seating device set data.

5. Test data substantiating the expected coefficients and anchorage slip.

C. Field Data – The following information, prior to installation on actual materials to be used, shall be submitted:

1. Stress-strain curve for a sample representing the production lot from which the prestressing tendons will be taken.

2. Notarized mill test reports for the tendons.

3. Results of all tests required in Paragraph 1.07C.2 including compliance with Paragraphs 2.02H to 2.02J for anchorage and couplings.

D. Samples: The following shall be submitted:

1. Samples shall be representative of finished exposed face showing typical range of color and texture. Samples shall be submitted and approved prior to commencement of manufacture.

2. Sample size: 12 inches by 12 inches by thickness indicated on the Contract Drawings, representative of the proposed finished product.

E. Quality Control Submittals: The following items shall be submitted:

1. Concrete mix designs.

2. Reports for all test results in compliance with the requirements of Paragraph 1.06D.

3. Air content tests and test reports for laboratory cured concrete cylinders in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

4. Independent laboratory tests for grout shall be in accordance with the requirements of Section 03 60 00 - Grouting. Grout exposed to the weather shall be free of discoloration and shall not require special surface treatments.

5. Design calculations for pranks, wall panels, slabs, troughs, structural concrete members and coping prepared and sealed by a Professional Structural Engineer licensed in the State of New York.

F. Sustainability Submittals:

1. Environmental Product Declarations

   a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

   a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All precast, prestressed structural concrete materials and appurtenances shall be properly protected in accordance with the manufacturer's requirements so that no damage or deterioration will occur from the time of shipment until installation is completed. All products and materials shall be delivered, stored and handled as follows:

1. All precast, prestressed concrete units shall be delivered to the project site in such quantities and at such times to maintain continuity of erection.

2. Precast, prestressed members shall not be transported away from the casting yard until the concrete has reached the minimum required twenty-eight (28) day compressive strength and a period of at least five (5) days has elapsed since casting, unless otherwise permitted by the Engineer.

   a. Precast, prestressed members shall not be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

3. Units shall be handled and transported in a position consistent with their shape and design in order to avoid stresses which could cause cracking or damage.
4. Transportation, site handling and erection shall be accomplished using acceptable equipment and methods by qualified personnel so that units shall not be damaged.
5. During handling, transporting, and storing, precast, prestressed concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the Shop Drawings.
6. Nonstaining resilient spacers of even thickness shall be placed between each unit.
7. Units shall be supported during shipment and storage on nonstaining shock-absorbing material.
8. Units shall be stored and protected so as to prevent contact with soil, staining, or physical damage.
    a. Units shall be stored on firm, level, and smooth surfaces to prevent cracking, distortion, warping or other physical damage.
    b. Stored units shall be placed so that identification marks are discernible, and so that product can be inspected.
    c. Units shall not be placed directly on ground.
    d. Stacked precast, prestressed units shall be separated by battens across full width of each bearing point.
    e. The top of tier stack shall not be used as storage.
9. Factory assembled parts and components shall not be dismantled for shipment unless written permission is received from the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Concrete shall conform to the requirements of Section 03 30 00 - Cast-in-Place Concrete with the color and finish matching that for structural concrete.

1. For precast and prestressed concrete items, minimum compressive strength of concrete at twenty-eight (28) days shall be 6,000 psi unless otherwise specified in the Contract. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

B. Concrete reinforcement shall conform to the requirements of the Section 03 21 00 - Reinforcing Steel.

C. Prestressing Strands:

1. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K in conformance with one of the following: ASTM A 416, ASTM A 421 and ASTM A 722.

2. Strands, wire, and bars not specifically listed in ASTM A 416, ASTM A 421, or ASTM A 722 are permitted to be used provided they conform to the minimum requirements of this Specification and do not have properties that make them less satisfactory than those listed in ASTM A 416, ASTM A 421, or ASTM A 722.

3. Tendons shall be clean and free of excessive rust, scale, and pitting. A light oxide coating is permissible.

D. Grease, wax, plastic, or bituminous material may be used as coating material for unbonded tendons. Throughout the range of temperatures anticipated for the structure, the coating material shall remain ductile and free from cracks and shall not become fluid. The coating shall be chemically non-reactive with the tendon, concrete, and the material used for sheathing. The coating shall adhere to and be continuous over the entire tendon length to be unbonded.

E. Sheathing for Bonded Tendons

1. Sheathing and duct-forming materials shall not react with alkalies in the cement, shall be strong enough to retain their shape and resist damage during construction, and shall prevent the intrusion of cement paste from the concrete. Sheathing and duct-forming material left in place shall not cause electrolytic action or deterioration.

2. The inside diameter of the sheathing or duct shall be at least 1/4 in. larger than the wire, bar, or strand tendon and shall have an inside cross-sectional area at least twice that of the net area of the tendon.

3. Sheathing shall have grout holes or vents at each end and at all high points except where curvature is small and the sheathing as determined by the Engineer is relatively level. Drain holes shall be provided at all low points if the tendon may be subjected to freezing after placing and before grouting.

F. Sheathing for unbonded tendons shall have sufficient tensile strength and water resistance to prevent damage or deterioration during transportation, storage at job

site, and installation. The sheathing shall be continuous over the unbonded length of the tendons. The sheathing shall prevent the intrusion of cement paste and the escape of coating material. The sheathing may be a continuous tube or spiral wrapping.

G. Sheathing at joints shall be connected with leak-tight sleeves or gaskets.

H. Bonded tendon anchorage tested in an unbonded state shall develop ninety (90) percent of the minimum specified ultimate strength of the prestressing steel, without exceeding anticipated set at time of anchorage, and without slip. Anchors which develop less than one hundred (100) percent of the minimum specified ultimate strength shall be applied only where the bond length is equal to or greater than, the bond length required to develop one hundred (100) percent of the minimum specified ultimate strength of the tendon. The required bond length between the anchorage and the zone where the full prestressing force will be developed under service and ultimate loads shall be provided. Bond length shall be determined by testing a full-sized tendon. If in the unbonded state, the anchorage develops one hundred (100) percent of the minimum specified ultimate strength, it need not be tested in the bonded state.

I. Unbonded tendon anchorages when permitted by the Engineer shall develop the minimum specified ultimate strength of the prestressing steel with an amount of permanent deformation which will not decrease the expected ultimate strength of the assembly. The total elongation under ultimate load of the tendon shall be not less than two (2) percent when measured over a minimum gage length of ten (10) feet.

J. Couplings shall be used only at locations indicated on the Contract Drawings. All couplings shall develop the minimum specified ultimate strength of the prestressing steel without exceeding anticipated set of either the coupling or the prestressing steel, and shall not reduce the ductility of the tendon below the minimum two (2) percent strain specified in Paragraph 2.02.I. Couplings in housings which permit necessary movements during stressing shall be enclosed. For bonded tendons, fittings shall be provided to allow complete grouting of all the coupling components.

K. Grout shall conform to Section 03 60 00 - Grouting.

L. Bearing pads shall be provided as shown on the Contract Drawings. Neoprene bearing pads shall conform to the requirements specified herein. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast, prestressed concrete.

M. Fine and coarse aggregates for exposed finish shall be obtained from a single source for the entire job. Aggregate shall be clean, hard, strong, durable and inert, shall be free of staining or deleterious material and shall conform to ASTM C 33 or C 330..

N. Anchors, clamps, dowels and similar ties for anchoring precast, prestressed concrete shall be of Type 316 stainless steel, of the sizes and types shown.

O. Mortar shall conform to Section 04 05 00 - Common Work Results for Masonry and shall match adjacent masonry work.

P. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication

1. Structural precast, prestressed concrete units shall be manufactured in accordance with PCI-MNL-116.

2. Cover for reinforcing steel shall be a minimum of 3/4-inch. Metal chairs, with or without coating, shall not be used on the finished face.

3. Because of the critical nature of the bond development length in prestressed concrete unit construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

4. Rigid molds shall be used to maintain units within specified tolerances conforming to the shape, lines and dimensions shown on the approved shop drawings. Molds shall be constructed to withstand vibration method selected.

5. Concrete shall be conveyed from the mixer to place of final deposit by methods which will prevent separation, segregation or loss of material. All concrete shall be consolidated in the mold by high frequency vibration, either internal or external, or a combination of both, to eliminate unintentional cold joints, honeycombing and to minimize entrapped air on vertical surfaces.

6. Precast, prestressed concrete units shall be cured in accordance with Section 03 30 00 - Cast-in-Place Concrete until such time as the compressive strength is high enough to ensure that stripping does not have any effect on the performance or appearance of the final product.

7. Each precast, prestressed concrete unit shall be marked corresponding to identification mark on Shop Drawings for unit location. Each precast, prestressed concrete unit shall be marked with the date of casting.

8. Structural precast, prestressed concrete units which do not meet the color and texture range or the dimensional tolerances shall be rejected if they cannot be satisfactorily corrected.

9. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast, prestressed members.

10. Finishing shall be in accordance with Section 03 35 00 - Concrete Finishing.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive precast, prestressed structural concrete units are properly prepared and completed to final elevations as shown on the Contract Drawings.

3.02 IMPLEMENTATION

A. Installation

1. Structural precast, prestressed concrete shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings.
2. Precast, prestressed concrete units shall be set level, plumb, square and true within allowable tolerances in accordance with PCI-MNL-120 and Paragraph 1.06D.6.
3. Temporary supports and bracing shall be provided as required to maintain position, stability and alignment as units are being permanently connected.
4. Non-loadbearing units shall be set dry without mortar. Specified joint dimensions shall be attained with steel or plastic spacing shims.
5. Precast, prestressed concrete units shall be fastened in place by bolting or welding or both, completing dry-packed joints, grouting sleeves and pockets, and placing cast-in-place concrete joints as indicated on the approved erection drawings. Precast, prestressed concrete units shall be fastened in place in accordance with details shown on the Contract Drawings.
6. Temporary lifting and handling devices cast into the precast, prestressed concrete units shall be completely removed. If protectively treated, however, devices not visible in the finished work may be left in place only where they do not interfere with the work of any other trade.
7. All anchors, clamps, dowels and similar ties shall be furnished and set for proper erection.
8. All joints shall be a uniform thickness as shown on the Contract Drawings.

B. Placement and Protection of Tendons and Accessories

1. A visual inspection shall be conducted to ensure that materials meet requirements of the Specification. The inspection shall include, but not be limited to, the following:
   a. Cleanliness of material and forms
   b. Location of materials and forms
   c. Proper tensioning of prestressing materials
2. Preparation
   a. A dependable high-pressure water supply of sufficient volume before beginning grouting shall be provided. Sheathing shall be freed of dirt and other foreign substances by thorough flushing with water immediately prior to grouting.
   b. Tendons and Concrete
      1) Tendons shall be kept dry and water shall be kept out of the conduit until flushing tendons prior to grouting. Concrete around grouted tendons shall be maintained at a temperature of forty (40) degrees Fahrenheit or higher from the time of grouting to at least three (3) days after grouting.
      2) Sheathing for use with bonded tendons shall be kept free of grease, oil, paint, and other foreign matter. A light coat of rust is permissible, provided loose rust has been removed and the surface of the steel is not pitted.
      3) Tendons for use in unbonded construction shall be kept clean and undamaged, and protected with a permanent coating specified in Paragraph 2.02D.
      4) Tendon shall be covered with an additional field-applied coating of acceptable material.
      5) End anchorage shall be permanently protected with concrete free of loose rust, grease, oil, and other foreign matter except paint.
      6) Grout fittings and sheathing for bonded tendons shall be protected from collapse and other damage. Prior to placing concrete, sheathing and grout fittings shall be examined for holes, and any holes found shall be repaired. If the tendon remains ungrouted for more than twenty-eight (28) days from the time of tendon placement, temporary corrosion protection shall be provided.
3. Placement
   a. Tendons and anchorage shall be installed to meet tolerances of Paragraph 1.06D.6. Tendons, sheathing, and anchorage shall be

firmly supported to prevent displacement during concrete placement.

b. Grout

1) For bonded-tendon construction, grout shall be injected into all voids between prestressing tendons, sheathing, and anchorage fittings. Flow shall be continued until grout of the same consistency as the grout injected flows without the presence of air bubbles from vent openings. Vent openings shall be closed progressively in the direction of the flow. After all vent openings have been closed, the grouting pressure shall be raised to at least fifty (50) psi and plug the injection hole.

2) In the event of a blockage or an interruption of grouting, all grout shall be removed from the tendon sheath by flushing with water.

4. Tensioning and Other Operations Involving Tendons

a. Tendons shall be stressed in the sequence, at the concrete strength, and at the construction stage as indicated on the Contract Drawings.

b. Tendons composed of multiple strands, wires, or bars in a common sheath shall be tensioned simultaneously unless the effects of interference between the elements are considered.

c. Prestressing force shall be determined by measuring tendon elongation and checking jack pressure with a calibrated gauge or dynamometer. Gauge or dynamometer shall be calibrated within six months prior to use; correct any discrepancy which exceeds five (5) percent. Elongation requirements shall be based on load-elongation curves for the steel used. For each tendon a record of the measured elongation and the gauge pressure or dynamometer readings shall be kept and submitted to the Engineer.

d. The total loss of prestress force in any tendon due to unreplaced broken elements shall not exceed two (2) percent of the total prestress force.

e. Tendons shall not be subjected to excessive temperatures, welding sparks, or electric ground currents. Burning and welding operations shall not be conducted in the vicinity of tendons without prior acceptance, except as permitted by Paragraph 3.02 B. 4. f..

f. Superfluous extension of tendons beyond anchorage may be removed by rapid oxyacetylene burning, unless these procedures are contrary to the recommendations of the manufacturer of the prestressing steel.

C. Repair

1. Concrete shall be repaired in accordance with the requirements of Sections 03 30 00 - Cast-in-Place Concrete. Where required, and subject to the approval of the Engineer, damaged exposed exterior surfaces shall be repaired to match color and texture of surrounding concrete and to minimize shrinkage.

D. Cleaning

1. After installation and joint treatment, precast, prestressed concrete surfaces shall be cleaned with detergent and water, using soft fiber brushes and sponges. Units shall be rinsed thoroughly with clean water in accordance with the precast, prestressed concrete manufacturer's recommendation. Cleaning materials and processes shall be used which will not change the character or color of exposed concrete finishes.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. Precast, prestressed structural concrete units shall be protected from all damage and abuse from all other Contractors and installers involved in the work until final acceptance by DEP.

END OF SECTION

SECTION 03 45 00 – PRECAST ARCHITECTURAL CONCRETE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Precast architectural concrete as specified herein shall include precast concrete items, and all accessories necessary.

B. Precast architectural concrete items shall be provided where shown on the Contract Drawings, specified in the Contract, or as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	11
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 - Sustainability Certification Project Requirements

B. Section 03 21 00 - Reinforcing Steel

C. Section 03 30 00 - Cast-in-Place Concrete

D. Section 03 35 00 - Concrete Finishing

E. Section 03 60 00 - Grouting

F. Section 07 62 00 - Sheet Metal Flashing and Trim

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1. Building Code of the City of New York

2.	AC1 318	-	Building Code Requirements for Reinforced Concrete
3.	AC1 347	-	Recommended Practice for Concrete Formworks
4.	AC1 533	-	Guide for Precast Concrete Wall Panels
5.	AWS D1.1	-	Structural Welding Codes - Steel
6.	AWS D1.4	-	Structural Welding Codes – Reinforcing Steel
7.	ASCE 7	-	Minimum Design Loads for Buildings
8.	ASTM A36	-	Specification for Carbon Structural Steel
9.	ASTM A153	-	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
10.	ASTM A325	-	Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
11.	ASTM A276	-	Specification for Stainless and Heat-Resisting Steel Bars and Shapes
12.	ASTM A416	-	Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
13.	ASTM A615	-	Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
14.	ASTM A666	-	Specification for Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Application
15.	ASTM C33	-	Specification for Concrete Aggregates

16.	ASTM C109	-	Test Method for Compressive Strength of Hydraulic Cement Mortars
17.	ASTM C138	-	Test method for Unit Weight, Yield, and Air Content of Concrete
18.	ASTM C150	-	Specification for Portland Cement
19.	ASTM C185	-	Test Method for Air Content of Hydraulic Cement Mortar
20.	ASTM C191	-	Test Method for Tensile Strength of Hydraulic Cement Mortars
21.	ASTM C260	-	Standard Specification for Air-Entraining Admixtures for Concrete
22.	ASTM C330	-	Standard Specification for Lightweight Aggregates for Structural Concrete
23.	ASTM C494	-	Standard Specification for Chemical Admixtures for Concrete
24.	AASHTO	-	Section 9 of AASHTO Standard Specifications for Highway Bridges
25.	ISO 14025	-	Environmental labels and declarations - Type III environmental declarations
26.	PCI MNL 116	-	Precast/Prestressed Concrete Institute, Manual of Quality Control for Plants and Production of Structural Precast Concrete Products
27.	PCI MNL 117	-	Precast/Prestressed Concrete Institute, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products"
28.	PCI MNL 120	-	Precast/Prestressed Concrete Institute "PCI Design Handbook," latest edition

1.05 DESCRIPTION

A. Load Calculations: Precast units shall be detailed and fabricated to withstand loads as calculated in accordance with the Building Code of the City of New York, and erection forces. Structural properties of the units shall be calculated in accordance with ACI 318.

B. Dimensions and Tolerances: Precast units shall be fabricated to dimensional tolerances in accordance with PCI-MNL-120. Units shall be designed to

accommodate construction tolerances, deflection of building structural members and clearances of intended openings.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications:

1. The precast concrete manufacturer shall have five (5) years of proven experience in the design and manufacture of precast concrete architectural items.

2. The precast concrete manufacturing plant shall meet the qualifications of certification by the Precast/Prestressed Concrete Institute Plant Certification Program. Qualifications shall be current at time of bidding.

B. Erector Qualifications: Regularly engaged for at least five (5) years in the erection of precast concrete architectural items similar to the requirements of this project (PCI certified erector, certified S2 or A).

C. Design Standards: Comply with ACI 318 and the design recommendations in PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete".

D. Quality-Control Standard: Comply with PCI MNL 116, "Manual for Quality Control; Precast and Prestressed Concrete".

E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel".

1.07 SUBMITTALS

A. The Contractor shall prepare and submit Shop Drawings and reference materials for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Fabricator Qualifications: Submit certification from PCI and a list of five (5) successfully completed precast jobs which are at least five years old. Include a detailed description of the fabricated item, project name, location, contractor, and architect or engineer.

2. Installer Qualifications: Submit a list of five (5) successfully completed precast jobs in the least five years old similar to those required for this Contract.

3. Catalog cuts, drawings, and color options

4. Shop Drawing: Placing drawings, including checked Shop Drawings for manufacture and erection of precast wall panels and copings and shall indicate:

a. Unit shapes, including elevations and sections, member piece marks and dimensions

b. Plans and elevations locating and defining all products furnished by the manufacturer

c. Finishes

d. Relationship to adjacent materials

e. Reinforcement, joint and connection details

f. Erection sequence and handling requirements

g. Lifting and erection inserts

h. All dead, live and applicable loads used in the design

i. Location, dimensional tolerances, and details of anchorage devices that are embedded in or attached to structure or other construction

j. Handling procedures, plans and/or elevations showing item location and sequence of erection for special conditions

1) Location where field drilling or cored opening are permitted

B. Samples: The following shall be submitted:

1. Samples shall be representative of finished exposed face showing typical range of color and texture. Samples shall be submitted and approved prior to commencement of manufacture.

2. Sample size: twelve (12) inches by twelve (12) inches by thickness indicated on the Contract Drawings, representative of the proposed finished product

C. Quality Control Submittals: The following items shall be submitted:

1. Concrete mix designs

2. Test reports for laboratory cured concrete cylinders

3. Air content tests in accordance with ASTM C 138 submitted with mix design

4. Independent laboratory tests showing that grout is nonshrink at various ages and shows no expansion after set when tested in accordance with ASTM C109, and has a placement time based on initial set of not less than sixty (60) minutes when tested in accordance with ASTM C191. Grout exposed to the weather shall be free of discoloration and shall not require special surface treatments.

5. Design calculations for architectural items prepared and sealed by a Professional Engineer licensed in the State of New York and recognized as an expert in the specialty involved. Calculations shall include all connections and all anchorage devices that are embedded in or attached to the structures.

6. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

7. Product design criteria:

a. Loadings for design:

1) Initial handling and erection stress limits.

2) All dead and live loads as specified on the contract drawings.

3) All other loads specified for members, where applicable.

b. As directed on the contract drawings, design calculations of products shall be performed, sealed and submitted for approval by an engineer registered in New York State, who is experienced in precast, prestressed concrete design.

c. Design shall be in accordance with applicable codes or the following specifications, standards and codes:

1) ACI 318

2) ASCE 7

3) PCI MNL-120

D. Engineering Data:

1. Submit complete design calculations for all precast members and connections. Indicate all design loads, including live loads, wind loads, seismic loads, and dead loads. Design calculations shall be performed, sealed and submitted by Precast Concrete Contractor's Professional Engineer, licensed to practice in New York State, who is experienced in precast, pre-stressed concrete design. Design calculations shall be based on requirements of Performance Requirements and product design criteria specified herein.

E. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor’s approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor’s New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All precast architectural concrete materials and appurtenances shall be properly protected in accordance with the manufacturer's requirements so that no damage or deterioration will occur from the time of shipment until installation is completed. All products and materials shall be delivered, stored and handled as follows:

1. Delivery: All precast concrete units shall be delivered to the project site in such quantities and at such times to maintain continuity of erection.

2. Orientation During Transport: Units shall be handled and transported in a position consistent with their shape and design in order to avoid stresses which could cause cracking or damage.

3. Equipment and Personnel: Transportation, site handling and erection shall be accomplished using acceptable equipment and methods by qualified personnel so that units shall not be damaged.

4. Lifting: Units shall be lifted or supported only at the points shown on the Shop Drawings.

5. Spacers: Nonstaining resilient spacers of even thickness shall be placed between each unit.

6. Support: Units shall be supported during shipment and storage on nonstaining shock-absorbing material.

7. Storage: Units shall be stored and protected so as to prevent contact with soil, staining, or physical damage.

a. Units shall be stored on firm, level, and smooth surfaces to prevent cracking, distortion, warping or other physical damage.

b. Stored units shall be placed so that identification marks are discernible, and so that product can be inspected.

c. Units shall not be placed directly on ground.

d. Stacked precast units shall be separated by battens across full width of each bearing point.

e. The top of tier stack shall not be used as storage.

B. Factory assembled parts and components shall not be dismantled for shipment unless written permission is received from the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Manufacturer shall warrant that the precast concrete architectural items will not spall or show evidence of visible cracking beyond accepted industry standards, splitting, deformation, or loosening resulting from inferior materials or workmanship by this trade for a period of one (1) year effective from the date of

the substantial completion of the precast erection. Precast units showing such defects will be repaired or replaced at the Engineer's option and made acceptable to industry standards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide precast concrete architectural items as manufactured by:

1. Empire Precast
2. Confab
3. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Concrete: Concrete shall conform to the requirements of Section 03 30 00 – Cast-in-Place Concrete and shall match the color and finish of the approved color sample.

B. Reinforcing: Concrete reinforcement shall conform to the requirements of Section 03 21 00 – Reinforcing Steel.

C. Grout: Cement grout shall consist of Portland Cement, sand and water sufficient for placement and hydration and shall conform to Section 03 60 00 - Grouting.

D. Aggregate: Fine and coarse aggregates for exposed finish shall be obtained from a single source for the entire project. Aggregate shall be clean, hard, strong, durable and inert, shall be free of staining or deleterious material and shall conform to ASTM C33 or C330. Aggregate shall be manufacturer’s standard aggregates required to produce custom color and texture matching Engineer’s sample.

E. Facing: Thickness of facing shall be a minimum of 1-inch to 1-1/2-inch, or shall be the maximum size of aggregate used, whichever is larger. Water-cement and cement-aggregate ratio of facing mix and backup mix shall be the same.

F. Accessories: Anchors, cramps, dowels and similar ties for anchoring precast concrete shall be of Type 316 stainless steel, of the sizes and types shown.

G. Grid Epoxy Coated Interlaid Carbon Fiber Mesh:

1. Yarn Type: Industrial grade Polyacrylonitrile (PAN) based carbon fiber, such as Zoltek Panex 35 or approved equal, size and strength as specified.
2. Binder Type: Epoxy D1156.
3. Yarn/Strand Direction: Warp and weft yarns/strands are to be laid perpendicular, with warp laid to within + ten (10) degrees of perpendicular with weft.
4. Cross Over Bond: machine direction - 145 pounds; cross-machine direction - 200 pounds.

5. Strands: No missing, broken, or degraded strands.

H. Bearing Pads:

1. Chloroprene (Neoprene): Conform to Div. II, Section 18 of ASSHTO Standard Specifications for Highway bridges.

2. Random Oriented Fiber Reinforced: Shall support a compressive stress of 3,000 psi with no cracking, splitting or delaminating in the internal portions of the pad.

3. Plastic: Multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.

I. Insulation:

1. Expanded Polystyrene (EPS) Board Insulation: Rigid, closed cell, expanded Polystyrene, R-Control PerformGuard EPS or approved equal, ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450 respectively, Type-II, 1.35 pounds per cubic foot, and with perforated polypropylene and/or polyethylene film face.

J. Cast-in Items:

1. All grouted connection tubes and lifting device covers shall use the appropriate Producer Solutions blow molded plastic accessory, as manufactured by High Concrete Accessories or approved equal, to produce a uniform void suitable to receive grouting or, where appropriate, to eliminate field patching of lifting devices.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General: Architectural precast concrete shall be manufactured in accordance with ACI-533. Fabricate items straight, smooth and true to size and shape with exposed edges and corners precise and square.

B. Reinforcing Cover: Cover for reinforcing steel shall be a minimum of 3/4-inch. Metal chairs, with or without coating, shall not be used on the finished face.

C. Molds: Rigid molds shall be used to maintain units within specified tolerances conforming to the shape, lines and dimensions shown on the approved Shop Drawings. Molds shall be constructed to withstand vibration method selected.

D. Concrete Conveying: Concrete shall be conveyed from the mixer to place of final deposit by methods which will prevent separation, segregation or loss of material. All concrete shall be consolidated in the mold by high frequency vibration, either internal or external, or a combination of both, to eliminate unintentional cold joints, honeycombing and to minimize entrapped air on vertical surfaces.

E. Curing: Precast concrete units shall be cured utilizing procedures in Section 03 30 00 – Cast-in-Place Concrete until such time as the compressive strength is high enough to ensure that stripping does not have any effect on the performance or appearance of the final product.

F. Identification: Each precast architectural concrete item shall be marked corresponding to identification mark on Shop Drawings for item location. Each precast concrete item shall be marked with the date of casting.

G. Rejection: Architectural precast concrete units which do not meet the color and texture range or the dimensional tolerances shall be rejected if they cannot be corrected to the satisfaction of the Engineer.

H. Finishing shall be in accordance with Section 03 35 00 – Concrete Finishing.

I. Fabrication procedures shall be in general compliance with PCI MNL-116.

J. Formwork: Comply with ACI 347. Prefabricated mold shall be one-piece seamless rigid molds for exposed faces. Prevent deformation of molds and maintain mold surfaces free of irregularities, dents, sags, or damage of any kind.

K. Anchorage Hardware: Fabricate with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations.

L. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.

M. Cast-in reglets, slots, holes, and other accessories in precast architectural concrete units to receive windows, cramps, dowels, reglets, waterstops, flashings, and other similar work as indicated.

N. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and PCI MNL 116 for fabricating, placing, and supporting reinforcement.

O. Reinforce precast concrete items to resist handling, transportation, and erection stresses.

P. Mix concrete according to PCI MNL 116 and requirements in this Section.

Q. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.

R. Identify pickup points of precast concrete items and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete item on a surface that will not show in finished structure.

S. Cure concrete, according to requirements in PCI MNL 116, by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

T. Fabricate precast concrete items straight and true to size and shape, with exposed edges and corners precise and true so each finished panel complies with PCI MNL 116 product tolerances as well as position tolerances for cast-in items.

U. Patching: Shall be acceptable providing the structural adequacy of the product and the appearance are not impaired.

V. Damaged, chipped or discolored units shall be replaced, patched or refinished as directed by the Engineer, and to their approval.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive precast architectural concrete items are properly prepared and completed to final elevations as shown on the Contract Drawings.

B. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Precast architectural concrete shall be installed in accordance with the manufacturer's recommendations and approved Working Drawings.

B. Tolerances: Precast concrete units shall be set level, plumb, square and true within allowable tolerances in accordance with PCI-MNL-120.

C. Temporary Supports: Temporary supports and bracing shall be provided as required to maintain position, stability and alignment as units are being permanently connected.

D. Setting Units: Non-loadbearing units shall be set dry without mortar. Specified joint dimensions shall be attained with 300 series stainless steel or plastic spacing shims.

E. Fastening Requirements: Precast concrete units shall be fastened in place by bolting or welding or both, grouting sleeves and pockets, and placing cast-in-place concrete joints as indicated on the approved Shop Drawings. Precast concrete items shall be fastened in place in accordance with design intentions shown on the Contract Drawings.

F. Removal of Temporary Devices: Temporary lifting and handling devices cast into the precast concrete units shall be completely removed. If protectively treated, however, devices not visible in the finished Work may be left in place only where they do not interfere with the work of any other trade.

G. All anchors, cramps, dowels and similar ties shall be furnished and set for proper erection.

H. All joints shall be a uniform thickness.

I. Joints shall be double sealed on exterior and singled sealed on inside face with polyurethane sealant, except interior surfaces to be painted shall be sealed with a latex sealant. Sealant shall be vented as recommended by precast manufacturer to prevent build up moisture. Completed sealant work shall be water tight, tightly adhered, smooth, and free of defects. Sealant color shall be selected by Engineer from manufacturer's full range.

J. Finish exposed-face surfaces of precast concrete items to match approved design reference sample and as follows: Smooth-Surface Form Finish: Free of pockets, sand streaks, and honeycombs, with "as cast" color and texture.

K. Site access: The Contractor shall be responsible for providing suitable access to the building, proper drainage and firm, level bearing for the hauling and erection equipment to operate under their own power.

L. Preparation of structures to receive precast items: The Contractor shall be responsible for:

1. Providing true, level bearing surfaces on all field placed bearing surfaces.
2. Placement and accurate alignment of anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.

M. Install precast concrete items:

1. Erection shall be carried out by competent erectors that are PCI qualified.
2. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
3. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

N. Anchor precast concrete units in position by bolting, welding, grouting, or as otherwise indicated.

O. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.

1. Repair damaged steel surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces or by re-priming damaged painted surfaces.

P. Install precast concrete wall units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 125 or 127.

Q. Subject to approval of the Engineer and precast Engineer, precast concrete items may be drilled or "shot" by other trades for attachment of other building components provided no contact is made with prestressing steel. Should spalling occur, repair of the spall shall be the responsibility of the trade doing the drilling or the shooting.

R. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains caused by the erector. If other trades cause damage, marks, dirt, or stains they shall be liable for the costs of cleaning or repair.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Repair

1. Repair of Exterior Surfaces: Concrete repairs shall meet the requirements of Section 03 30 00 – Cast-in-Place Concrete. Where required, and subject to the approval of the Engineer, damaged exposed exterior surfaces shall be repaired to match color and texture of surrounding concrete and to minimize shrinkage.

B. Protection

1. Protect precast architectural concrete units from all damage and abuse from all other Contractors and installers involved in the Work until Final Acceptance by DEP.

C. Cleaning

1. After installation and joint treatment, precast concrete surfaces shall be cleaned with detergent and water, using soft fiber brushes and sponges. Units shall be rinsed thoroughly with clean water in accordance with the precast concrete manufacturer's recommendation. Cleaning materials and processes shall be used which will not change the character or color of exposed concrete finishes.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 03 60 00 - GROUTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates as specified herein and shown on the Contract Drawings.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Implementation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 63 – Sustainability Certification Project Requirements

B. Section 03 30 00 - Cast-in-Place Concrete.

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1.	ASTM C109	-	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens).
2.	ASTM C531	-	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings.
3.	ASTM C579	-	Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings.
4.	ASTM C939	-	Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
5.	ASTM C1107	-	Packaged Dry, Hydraulic Cement Grout (Nonshrink).
6.	CRD-C 621	-	Corps of Engineers Specification for Non-shrink Grout.
7.	ISO 14025	-	Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. Services of Manufacturer’s Representative

1. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the non-shrink grout and epoxy grout.

2. The manufacturer's representative shall provide written certification that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

3. The on-site time required for the manufacturer's representative to achieve a successful installation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the

Resident Engineer and provide written verification of the areas he has approved on each day he is at the Project.

B. Grout Uses

1. The different types of grout shall be used for the applications stated below unless noted otherwise specified herein or on the Contract Drawings. Where grout is called for in this Section or on the Contract Drawings which does not fall under any of the applications stated below, non-shrink grout shall be used.

   a. Cement grout shall be used for grout toppings and for patching of fresh concrete.

   b. Non-shrink grout shall be used for grouting beneath base plates of equipment and structural metal framing.

   c. Epoxy grout shall be used for bonding new concrete to hardened concrete.

2. New concrete surfaces to receive cement grout shall be as specified in Section 03 30 00 – Cast-in-Place Concrete, and shall be cleaned of all dirt, grease and oil-like films.

   a. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, 4 protection of cement grout shall be as specified in Section 03 30 00 – Cast-in-Place Concrete.

   b. Curing and protection of cement grout shall be as specified in Section 03 30 00 – Cast-in-Place Concrete.

3. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

1.06 QUALITY ASSURANCE

A. Testing Agency:

1. Testing of materials and of resulting grout for compliance with the technical requirements of the Contract will be performed by QA/QC consultant employed and paid by DEP.

   a. The Contractor shall be charged by DEP for the cost of any additional tests and investigation on work performed which does not meet the Contract.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Shop drawings shall include, but not be limited to:

1. Material certifications and technical data sheets.

2. Samples of all materials to be used.

B. The Contractor shall also submit the following:

1. Certified test results verifying the compressive strength, shrinkage and expansion requirements specified herein.

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the Work.

C. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Epoxy grout:

1. Sikadur 32 Hi-Mod as manufactured by Sika Corporation, Lyndhurst, NJ.

2. Euco #452 as manufactured by Euclid Chemical, East Brunswick, NJ.
3. Duralcrete LV as manufactured by Tamms Industries, Kirkland, IL.
4. Or approved equal.

B. Non-shrink grout shall be:

1. Euco N-S as manufactured by Euclid Chemical Company, East Brunswick, NJ.
2. Masterflow 713 as manufactured by Master Builders Solutions, Shakopee, MN.
3. Sikagrout 212 as manufactured by Sika Corporation, Lyndhurst, NJ.
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Cement Grout

1. Cement grout shall be composed of Portland cement, sand and water. The sand to be used shall be selected to suit the spacing for placement. Where sand is not usable, the grout shall be composed of cement and water only.
2. Gradation of sand and mix proportioning shall be in accordance with the following table for grouts using natural sands and having a minimum 28-day compressive strength of 4,000 psi. For higher strength grouts or those using manufactured sands, strength shall be established by trial mixes.

a. Gradation for Natural Sand:

Sieve Size	Spaces less than one (1) inch	Spaces one (1) inch or more
Passing 3/8		100
Passing 4	100	95-100
Passing 8	95-100	80-100
Passing 16	70-100	50-85
Passing 30	40-75	25-60
Passing 50	10-35	10-30
Passing 100	2-15	2-10
Passing 200	--	--

b. Mix Proportioning:

By Weight	Non-Air Entrained Grouts (Maximum 4 Percent Entrapped Air)		Air Entrained Grouts (Air 8 Percent to 10 Percent)	
	Spaces less than one (1) inch	Spaces one (1) inch or more	Spaces less than one (1) inch	Spaces one (1) inch or more
Cement (bags)	10.8	10.5	11.3	11.0
Sand (lb)	2150	2240	1930	1990
Maximum water (gals)	59.5	57.8	57.5	55.8
Maximum water (gals per bag)	5.5	5.5	5.1	5.1

By Volume	Non-Air Entrained Grouts (Maximum 4 Percent Entrapped Air)		Air Entrained Grouts (Air 8 Percent to 10 Percent)	
	Spaces less than one (1) inch	Spaces one (1) inch or more	Spaces less than one (1) inch	Spaces one (1) inch or more
Cement	1	1	1	1
Sand (dry rodded)	1.85	2.10	1.6	1.7
Sand (damp & loose)	2.30	2.35	2.0	2.1
Maximum water (gals per bag)	5.5	5.5	5.1	5.1

3. Water shall be kept to a minimum, the amounts noted in the preceding table are the maximum for grout. Proportioning by volume shall be limited to small quantities mixed at the job Site.

4. White Portland cement shall be mixed with the Portland cement as required to match the color of adjacent concrete.

B. Non-Shrink grout

1. The grout material shall be an approved ready to use mixture requiring only water for use at the job site. The compressive strength of two (2)-inch cubes shall be 3,000 psi at seven (7) days.

2. Non-shrink grout shall conform to CRD-C 621 and ASTM C1107, Grade B or C when tested at a maximum fluid consistency of thirty (30) seconds per ASTM C939 at temperature extremes of forty-five (45) degrees Fahrenheit and ninety (90) degrees Fahrenheit and an extended working time of fifteen (15) minutes.

3. Non-shrink grout product and manufacturer shall be as specified in this Section.

4. Non-shrink grouts depending on oxidation to limit shrinkage and containing additives such as iron or steel particles shall not be used.

C. Epoxy Grout

1. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

2. Epoxy grout product and manufacturer shall be as specified in this Section.

D. Dry Pack

1. Dry pack (to be packed or tamped in place) shall be made at no slump consistency.

2. When mixing the batch, only enough water shall be added to the dry materials to produce a rather stiff mixture, then additions of water may be made in small increments until the desired consistency is obtained.

E. Curing Materials

1. Curing materials for cement grout shall be as specified in Section 03 30 00 – Cast-in-Place Concrete and as recommended by the manufacturer for prepackaged grouts.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Installation

1. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency shall be such that the grout is plastic and moldable but will not flow.

2. Measurements for cement grout shall be made accurately by weight or by volume using containers. All measurements shall be made in a manner satisfactory to the Engineer. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted, be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped.

4. For grouting beneath base plates, grout shall be poured from one side only and shall flow across to the open side to avoid air-entrapment.

5. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with the Contract.

2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven (7) days, twenty-eight (28) days and any additional time period as appropriate.

3. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven (7) days and any other time period as appropriate.

B. All grout which has already been placed and which fails to meet the requirements of this Section is subject to removal and replacement by the Contractor at no additional cost to DEP.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 04 01 00 – MAINTENANCE OF MASONRY
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Masonry and stonework restoration and cleaning as specified herein shall include, but not be limited to masonry replacement, stone repair, tuck pointing, hydro-air cleaning, and all accessories and appurtenances.

B. Masonry and stonework restoration and cleaning shall be provided as required in the Contract Documents and as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Implementation	4
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 04 05 00 - Common Work Results for Masonry

B. Section 04 21 02 - Exterior Brickwork

C. Section 04 22 00 - Concrete Unit Masonry

D. Section 04 40 00 - Stone Assemblies

1.04 REFERENCES

A. Acronyms:

1. Indiana Limestone Institute of America, Incorporated (ILI)

B. Reference Standards:

1. ILI – Repairing Damage to Indiana Limestone: A Basic Guide
2. ILI - How to Avoid Small Area Stains and Blemishes

1.05 DESCRIPTION

A. Environmental Requirements

1. Temperature: Masonry and stonework shall not be repointed, caulked, washed down, or wetted when temperature may drop below forty (40) degrees Fahrenheit within twenty-four (24) hours.
2. Air Quality: Cleaning processes creating dust or dirt shall not be performed when wind is in excess of ten (10) miles per hour.

1.06 QUALITY ASSURANCE

A. Experience: Masonry and stonework restoration and cleaning work shall be performed by a company with a minimum of five (5) years documented experience in this type of Work.

1.07 SUBMITTALS

A. Qualifications and Experience: Submit list of a minimum of five (5) completed projects of similar size and complexity to this Work. Include for each project:

1. Project name and location
2. Name of owner
3. Name of engineer
4. Type of restoration
5. Approximate area of restoration work
6. Date of completion

B. The Contractor shall prepare and submit Shop Drawing and reference materials for approval of the Engineer. Submittals shall include but not be limited to the following:

1. Catalog cuts.
2. Drawings.
3. Literature: The Contractor shall submit literature showing the type of materials and equipment to be used in all masonry and stonework cleaning operations. This shall include the manufacturer's technical data for each product specified. Include test data and certifications substantiating that

products comply with requirements. Safety Data Sheets (SDS) as appropriate.

4. Test Patches: The Contractor shall clean small test areas of all types of surfaces to be cleaned. The test patches shall be approved by the Engineer before beginning full scale cleaning operations on any surface.

5. Restoration Program: Submit written program for each phase of restoration process including protection of surrounding material on building and site during operations. Describe in detail material methods and equipment to be used for each phase of restoration work.

6. Methods of Mortar Removal - Submit a description of the tools to be used for mortar removal.

7. Submit written plan and diagrams for method of containment of water used for cleaning and blast cleaning and its disposal.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Restoration and cleaning materials delivered and stored at the Site shall be from approved manufacturers and sources only. Restoration and cleaning materials shall be delivered and stored in manufacturer's packaging, and shall include all instructions for use.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide cleaners as manufactured by the following:

1. Cathedral Stone Products, Inc., Hanover, MD

2. Dumond Chemicals, Inc., New York, NY

3. EaCo Chem, Inc., Forestville, PA

4. Or an approved equal

2.02 MATERIALS / EQUIPMENT

A. Mortar: Mortar materials shall be as specified in Section 04 05 00 - Common Work Results for Masonry.

B. Masonry and Stone Materials: Replacement masonry and stone materials shall be as specified in the Contract.

C. Cleaning Solution: Cleaning solution shall consist of a clean, stain-free, commercial cleaner mixed according to manufacturer's instructions. Per the National Park Service Preservation Brief 1, muriatic acid cleaners are not to be used on historical masonry, and other cleaners should be tested on an inconspicuous area first.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. Not Used

B. Preparation

1. Adjacent Elements: Elements surrounding the Work of this Section, which shall include, but not be limited to, fixtures, fittings, finishing hardware, roof and roofing materials, and flashing, shall be protected from damage or disfiguration.

2. Occupied Areas: Occupied areas shall be closed off from the Work of this Section by means of dustproof and weatherproof temporary partitions.

3. Temporary Structural Support: The existing structure shall be needled, shored or supported as necessary prior to cutting out damaged units.

4. Demolition: Where indicated on the Contract Drawings, damaged and deteriorated masonry and stone shall be cut out in a manner to prevent damage to any adjacent remaining materials. All loose or unsound adjoining masonry, mortar, or stone shall be cut away to provide firm, solid bearing for new Work.

3.02 IMPLEMENTATION

A. Rebuilding:

1. Replacement masonry and stonework shall be built in to match and align with existing, with all joints and coursing true and level, and faces plumb and in line. All anchors, ties, reinforcing, stone cramps and dowels and flashings shall be correctly located and built in.

B. Masonry Replacement:

1. Masonry replacement shall be in accordance with Sections 04 21 02 – Exterior Brickwork and 04 22 00 – Concrete Unit Masonry.

C. Stonework Replacement:

1. Stonework replacement shall be in accordance with Section 04 40 00 - Stone Assemblies.

D. Stonework Repair

1. Where indicated, repair of damaged stonework shall be in accordance with the ILI Repair Booklet and the ILI How to Avoid Small Area Stains and Blemishes Manual.

E. Brick Masonry Tuck Pointing

1. Preparing Joints: Masonry mortar joints shall be raked out by hand cutting or grinding to a depth of 5/8-inch to allow new mortar to bond directly to the masonry units on both sides of the joint. Following the removal of mortar, the joints and edges of masonry units shall be thoroughly cleaned of all dust and loose mortar. Prior to tuck pointing with the mortar specified, the joints shall be thoroughly wetted down, assuring that edges and backup are sufficiently moist. This is particularly important during hot, windy, summer weather. Where special products are specified for pointing mortar, the work shall be prepared and performed in strict compliance with the manufacturer's recommendations. Do not tuck point during freezing weather.

2. Pointing: The cutout joints shall be completely filled with mortar. Care shall be exercised such that too much mortar is not applied at one time. Small amounts of mortar shall be placed and forced back to the foundation of the joint with a tool narrower than the joint being pointed.

3. Replacement: Damaged or missing brick shall be replaced with new brick to match the existing brick.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning

1. Hydro-air cleaning: An approved acid solution shall be applied to all exterior brick and stone surfaces using fiber brushes. The solution shall be allowed to remain on the masonry surfaces for sufficient time to loosen adhered grime and dirt. The solution shall be removed by the hydro-air cleaning method. A wet blast of air and cold water shall be applied by means of a heavy-duty hose equipped with nozzles adapted to produce 1,500 to 2,000 psi nozzle pressure. The acid solution, dust and loose particles of mortar shall be completely neutralized and removed by means of the wet

blast. All wood, metal, glass and other materials shall be protected during the cleaning operations.

END OF SECTION

SECTION 04 05 00 – COMMON WORK RESULT FOR MASONRY
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Mortar and masonry grout as specified herein include, but are not limited to, Portland Cement, lime, sand, coarse aggregate, admixtures for use in mortar and masonry grout, and appurtenances.

B. Mortar and masonry grout shall be provided as indicated on the Contract Drawings, specified herein, or as required for a complete installation.

C. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 04 21 02 - Exterior Brickwork

B. Section 04 22 00 - Concrete Unit Masonry

1.04 REFERENCES

A.	ASTM C91	-	Standard Specifications for Masonry Cement
B.	ASTM C144	-	Standard Specification for Aggregate for Masonry Mortar
C.	ASTM C150	-	Standard Specification for Portland Cement
D.	ASTM C207	-	Standard Specification for Hydrated Lime for Masonry Purposes
E.	ASTM C270	-	Standard Specification for Mortar for Unit Masonry
F.	ASTM C404	-	Standard Specification for Aggregates for Masonry Grout
G.	ASTM C476	-	Standard Specification for Grout for Masonry
H.	ASTM C595	-	Standard Specification for Blended Hydraulic Cement
I.	ASTM C780	-	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
J.	ASTM C1329	-	Standard Specification for Motor Cement
K.	ASTM C1019	-	Standard Test Method for Sampling and Testing Grout
L.	NYCBC	-	Section BC 2103 Masonry Construction Materials, BC 2104 Construction

1.05 DESCRIPTION

A. Where questions of compliance with the requirements of this Section arise, the specifications for mortar properties shall take precedence over the specification for mortar proportions.

B. No change shall be made in the proportions established for mortar approved under the specifications for mortar properties nor shall material with different physical characteristics be utilized in mortar used in the work unless compliance with the specifications for mortar properties are re-established by Shop Drawing data submission to Engineer.

C. Two different air-entraining materials shall not be combined in mortar or grout.

D. Sustainable Design Requirements:

1. Recycled Content of Mortar and Masonry Grout Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than fifteen (15) percent.

E. Project-specific system/ design requirements will be provided in the Contract, if necessary, to supplement requirements given herein or Contract Drawings.

1.06 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. The Contractor shall engage an independent testing agency to conduct tests specified herein and as follows:

1. Mortar: Mortar tests shall be performed in accordance with ASTM C270.

2. Grout: Grout tests shall be performed in accordance with ASTM C1019.

D. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-hour and similar designations), proportion mortar and masonry grouts to comply with the requirements established by UL and other governing authorities having jurisdiction at the Project Site.

1.07 SUBMITTALS

A. The Contractor shall submit the Shop Drawings for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Product Data: Manufacturer’s specifications and installation instructions for proprietary materials.

2. Certificates: Notarized certificates that the following comply with the specified requirements:

a. Portland Cement

b. Hydrated lime

c. Mortar and grout aggregates

3. Design Mix: Certified design mix for mortar and grout.

4. Test Results: Results of mortar and grout tests as specified herein and as specified in referenced standards.

5. Samples:

a. Each type of colored mortar in metal channels at least six (6)-inches long, showing the range of color that can be expected in the finished Work.

b. Complete selection of standard and custom colors of epoxy grout used for pointing mortar, for final selection by Engineer.

c. Label samples to indicate type and amount of colorant used. Engineer's review will be for color only. Compliance with all other requirements is the responsibility of the Contractor.

6. Construction: Weight slips for grout materials at time of delivery.

7. Schedule of locations where each mortar and grout type will be used in the Work.

B. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

c. The percentage (by weight) of post-consumer and pre-consumer recycled content.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Site before the time of installation.

2. Materials delivered and stored at the Site shall be from approved manufacturers and sources only.

3. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. Cement shall be stored in weathertight containers that exclude moisture and contaminants.

3. Hydrated lime shall be stored in weathertight containers that exclude moisture and contaminants.

4. Aggregates shall be kept clean and free from other materials during transportation and handling. Aggregate shall be stockpiled in a manner to prevent segregation.

5. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled in such a manner to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work.

3. Materials shall be handled in such a manner to prevent inclusion of contaminants.

4. Packages or containers shall not be opened until all preparatory work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mortar and masonry grout materials shall be as manufactured by:

1. Glen-Gery, Wyomissing, PA

2. Southern Heritage Masonry, Atlanta, GA

3. MAPEI, Dalton, GA

4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Portland Cement:

1. Provide Type I or III Portland Cement that conforms to the requirements of ASTM C150.

2. Provide nonstaining Portland Cement of natural color or of the color required to be compatible with the required colored mortar pigment selected by Engineer.

B. Hydrated Lime: Provide Type S hydrated lime that conforms to the requirements of ASTM C207.

C. Sand for Mortar: Provide natural sand that conforms to the requirements of the following:

1. ASTM C144, except for joints less than 1/4 inch use aggregate graded with one hundred (100) percent passing the No. 16 sieve.

2. White Mortar Aggregates: Provide natural white sand or ground white stone for Portland cement-lime mortars, as required for compatibility with mortar colors selected by Engineer.

3. Colored Mortar Aggregates: Provide ground marble, granite or other sound stone, as required to match the sample approved by Engineer for Portland Cement-lime mortars.

D. Aggregates for Grout: Provide fine and coarse aggregates that conform to the requirements of ASTM C404, ASTM C476.

E. Coloring Additive: A mineral-oxide pigment, harmless to mortar set and strength shall be provided. Colors shall be as selected by the Engineer.

F. Epoxy Pointing Mortar:

1. Provide a two-component non-sag epoxy resin and hardener with mineral filler complying with ANSI A118.3.

2. Colors: Complete selection of standard and custom colors for final selection by Engineer.

3. Provide epoxy mortar capable of water-cleanup during installation but which, after curing, is waterproof.

G. Water: Provide clean and potable water from approved sources.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Mixes for Mortar: Provide mortar that conforms to the requirements of ASTM C270, except as modified herein, and of the type and color to match the existing mortar.

1. Provide a cement-lime mortar; masonry cement mortars are not acceptable.

2. Calcium chlorides are not permitted.

3. Admixtures shall not be used unless specifically directed by the Contract.

4. Grout: Provide grout that conforms to the requirements of ASTM C476, ASTM C404 for fine or coarse grout.

B. Mixes for Grout: Provide grout that conforms to the requirements of ASTM C476, ASTM C404 for fine or coarse grout.

1. Fine grout shall be used for filling spaces with openings less than two (2) inches.

2. Course grout shall be used for filling spaces with openings greater than two (2) inches.

C. Measurement of Materials:

1. Cement and Hydrated Lime: Batched by the bag.
2. Sand: Batched by volume in suitably calibrated containers. Make allowance for bulking and consolidation, and for weight per cubic foot of contained moisture.
3. Proportion of Volumetric Mixtures: One ninety-four (94)-pound sack of Portland cement and one fifty (50)-pound sack of hydrated lime constitute nominal one cubic foot.
4. Shovel measurement: Not permitted.

D. Mortar:

1. All cementitious materials and aggregates shall be mixed between three and five minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Mortar shall not be hand mixed.
2. When required, cement and pigment shall be mixed for colored mortar prior to mixing in mortar. The maximum percentage by weight of cement for pigment shall be limited to ten (10) percent.
3. Limit batch size to avoid retempering.
4. Mortar that has begun to stiffen or is not used within two (2) hours after initial mixing shall not be used.
5. The mixer drum shall be completely emptied before recharging the next batch.

E. Mortar Temperature:

1. For temperatures below forty (40) degrees Fahrenheit mortar materials shall be heated to protect both mortar and completed work from freezing.
2. When outside air temperature is:
   a. Twenty-five (25) to forty (40) degrees Fahrenheit: Mixing water and sand shall be heated to produce mortar temperature between forty (40) and one hundred and twenty (120) degrees Fahrenheit. Temperatures of mortar on boards shall be maintained above freezing.
   b. Below twenty-five 25 degrees Fahrenheit: Masonry shall not be installed.
3. Ideal mortar temperature is seventy (70) degrees F + ten (10) degrees Fahrenheit. Mixing temperature selected shall be maintained within ten (10) degrees Fahrenheit.
4. Antifreeze compounds or calcium chloride in mortars shall not be used to lower the freezing point or accelerate setting.

F. Grout: Grout shall be mixed in accordance with the requirements of ASTM C476.

G. Epoxy Pointing Mortar: Epoxy pointing mortar shall be mixed in strict accordance with the manufacturer's instructions.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Prior to placing mortar or grout, remove laitance, loose aggregate and any substance that may prevent mortar or grout from bonding to the foundation.

3.02 INSTALLATION

A. Installation of mortar and grout shall be in accordance with the requirements of Sections 04 21 02 – Exterior Brickwork and 04 22 00 – Concrete Unit Masonry.

B. Installation of epoxy grout shall be in accordance with the manufacturer's instructions and recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Mortar shall be prepared and tested for preconstruction and construction evaluation in accordance with the requirements of ASTM C780. Specimens for construction evaluation shall be prepared a minimum of every five hundred (500) square feet of masonry construction.

B. Grout shall be prepared and tested for construction evaluation in accordance with the requirements specified in ASTM C1019 and NYCBC Section BC 2104. Specimens shall be prepared a minimum of every 100 cubic feet of grout placed.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. If any adjustment are needed after installation, the Contractor shall make those adjustments with care, to maintain consistency with the work completed.

B. It is the Contractor's responsibility to protect all completed work in and around the site. Any damage done to the completed work during construction shall be fixed at no extra charge to DEP.

C. The Contractor is also responsible for cleaning up after the work under this Section has been completed, to maintain a clean and neat site.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Brickwork as specified herein includes, but is not limited to, face brick, , reinforcement, anchorage, and all accessories and appurtenances.

B. Brickwork shall be provided as indicated on the Contract Drawings, specified herein, or as required for a complete installation.

C. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 04 05 00 - Common Work Results for Masonry

B. Section 05 50 00 - Metal Fabrications

C. Section 07 62 00 - Sheet Metal Flashing and Trim

1.04 REFERENCES

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C. ASTM C90 - Standard Specification for Load-Bearing Concrete Masonry Units

D. ASTM C126 - Standard Specification for Ceramic glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

E. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale)

F. Masonry Standards Joint Committee (MSJC):

1. TMS 402/ACI 530/ASCE 5 - Building Code Requirements for Masonry Structures

2. TMS 602/ACI 530.1/ASCE 6 - Specification for Masonry Structures

G. New York City Building Code Section BC 2103 Masonry Construction Materials, BC 2104 Construction

1.05 DESCRIPTION

A. Provide masonry accessories of sizes, dimensions and configurations coordinated with unit masonry construction system component sizes, dimensions and configurations.

B. Where continuous horizontal cavity wall reinforcement is specified as providing restraint for cavity wall insulation, coordinate dimensions with thickness of cavity wall insulation specified for proper clearances.

C. Where structural steel will be provided with fireproofing do not use welded-on channel slots. Coordinate required offset of welded-on wire ties with depth of fireproofing.

D. Bricks: Limit total moisture absorption until time of installation to the maximum percentage specified for the type of units for the average annual relative humidity as reported by the United States Weather Bureau Station nearest the Site and the corresponding percentage of total linear drying shrinkage of the concrete masonry units.

E. Comply with ASTM C90 Climatic Map establishing criteria for percent annual mean relative humidity.

F. Structural elements of masonry shall conform to the requirements of TMS 402/ ACI 530/ASCE 5 for materials and installation.

G. Masonry materials and installation shall conform to the requirements of TMS 602/ACI 530.1/ASCE 6.

H. Sustainable Design Requirements:

1. Recycled Content of Clay Unit Masonry: Postconsumer recycled content plus one-half of preconsumer recycled content not less than fifteen (15) percent.

2. Regional Materials: Unit Masonry shall be manufactured within five-hundred (500) miles of Project Site, from materials that have been extracted, harvested, or recovered within five hundred (500) miles of Project Site.

1.06 QUALITY ASSURANCE

A. Source Quality Control: Provide all metal sheet, wire, plate and bar stock masonry accessories from the same manufacturer.

B. Sample Panel: The Contractor shall erect a composite four (4) feet long by three (3) feet high sample panel.

1. The sample panel shall include facing veneer, bond pattern, mortar color, tooled joints, insulation, reinforcing, and backup.

2. Upon approval, the sample panel shall remain in place for the duration of exterior brick construction and shall be used as a basis of comparison for all exterior brickwork.

3. After final approval of finished exterior brickwork by the Engineer, the Contractor shall demolish the sample panel, and shall perform all Site-restoration Work.

4. Exterior brickwork shall not be started until the specified sample panel has been approved. The sample panel shall be used as a standard for comparison of exterior brickwork. Sample panel shall be destroyed only after all exterior brickwork has been completed and approved by the Engineer.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and other material for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Catalog cuts, drawings and reference materials.

2. Samples: The Contractor shall submit three (3) samples each of exterior brick that are representative of the full range of color, shading and texture of the material to be provided.

3. Test Reports: The Contractor shall submit material test reports or manufacturer's certificate of compliance for exterior brick.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements.
2. Provide drawings and material schedules showing all dimensions and sizes of brick accessories coordinated with exterior brickwork construction work, and other Work in which masonry accessories will be embedded, be supported from, or restrain.
3. Indicate methods for identifying and coordinating, at the Site, the location and accurate placement of each brick accessory in exterior brickwork construction as the work progresses. Indicate by letter of transmittal that items which must be installed in the shop have been received in time for proper sequencing of the Work to avoid delays.
4. Explanation of where each brick accessory will be used in the work, quantities purchased and intended spacings indicating compliance with code requirements.
5. Show all details for each condition encountered in the Work. Provide plan and elevation views drawn at 1/4-inch scale and details drawn at 1-1/2-inch scale. Show all items required to be built into exterior brick construction.
6. Masonry control joint locations and details.
7. Drawings showing the location, extent and accurate configuration and profile of all items shown, specified and required by this and other Sections to be built into the exterior brickwork construction as the Work progresses. Provide elevations drawn at 1/4-inch scale and all details drawn at 1-1/2-inch scale.
8. Drawings for fabrication, bending, and placement of reinforcing bars. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for exterior brickwork construction.

C. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content and Regional Materials. Provide the following information:
    a. Name of Product and Manufacturer.
    b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).
    c. The percentage (by weight) of post-consumer and pre-consumer recycled content for the submitted product.
    d. Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: All products and materials shall be delivered, stored, and handled as follows.

B. Delivery and Storage: Brickwork materials delivered and stored at the site shall be from approved manufacturers and sources only.

C. Bricks:

1. Bricks shall be handled in a manner which prevents undue breakage or chipping.

2. Bricks shall be unloaded using brick clamps.

3. All bricks shall be stored on platforms under shelter or in another approved manner so as to protect these materials from soil and weather.

D. Rejection:Face bricks, that are warped, cracked or of inferior quality will be rejected. Such items shall be removed from the site and not offered again for inspection.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers of brickwork items shall be:

1. Belden Brick Company

2. Consolidated Brick

3. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Clay Masonry Units: Face brick shall conform to ASTM C216 Grade SW Type FBX.

1. For exterior walls, the Contractor shall provide Type 316 stainless steel for anchors, anchor slots, ties and horizontal reinforcement.

B. Deformed reinforcing bars shall conform to ASTM A615/A615M Grade 60.

C. Horizontal Joint Reinforcement: Horizontal reinforcing shall be two (2) inches less in width than the actual thickness of the wall or partition in which it is to be placed.

1. Solid exterior clay masonry unit walls: Walls shall be reinforced horizontally with truss type, standard 9 gauge (.148-inch) by 9 gauge (.148-inch). Reinforcing shall be spaced at 16-inch centers vertically.
2. Exterior Cavity Walls: Walls shall be reinforced horizontally with truss type 9 gauge (.148-inch) by 9 gauge (.148-inch) reinforcing in the inner wythe with rectangular pintle and seismic clip to continuous 9 gauge wire reinforcing in the outer wythe. Reinforcing system shall include insulation clip washers. Reinforcing shall be spaced at a minimum of 16-inch centers vertically.
3. Corners: Corners shall be reinforced with the same type as wall reinforcing, standard 9 gauge (.148 inch) by 9 gauge (.148-inch), spaced in the same course as the wall reinforcing.
4. Intersections: Intersections between walls and partitions shall be reinforced horizontally with same type as wall reinforcing, standard 9 gauge (.148-inch) by 9 gauge (.148-inch), spaced in the same course as the wall reinforcing.

D. Dovetail Anchors: Dovetail anchors shall be 1/8-inch by 1-inch by 2-inch with 3/16-inch diameter wire.

E. Rigid Anchors: Rigid steel anchors shall be 1 inch wide (minimum), 3/16 inch thick, and 18 inches long between bent ends. Each end shall be bent down 3 inches (minimum) into mortar filled masonry cells.

F. Column Anchors: Brickwork shall be anchored to columns at 24-inch centers with stainless steel anchors.

G. Metal Fastenings: Bolts, metal wall plugs or other approved metal fastenings for securing items to brickwork and elsewhere shall be provided and installed as necessary.

H. Weep Holes: Weep holes shall be provided where shown, and shall consist of clear polyethylene, medium density plastic, rectangular tubes, 3/8 inch wide, 1-1/2 inches high, 3-1/2 inches deep.

I. Weep Vents: Weep vents shall be provided where shown, and shall be an offset T-shaped vent injection molded from flexible polyvinyl chloride. The vents shall be provided in a custom size and color to match brick and mortar as specified in the Contract.

J. Mortar Net: Mortar net shall be of high density polyethylene and shall be one inch nominal thickness.

K. Mortar Materials: Mortar materials shall be in accordance with Section 04 05 00 – Common Work Results for Masonry.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

1. Environmental Conditions: Materials and surrounding air temperature shall be maintained at a minimum fifty (50) degrees Fahrenheit prior to, during, and seventy-two (72) hours after completion of exterior brick work. Exterior brickwork shall not be erected when the ambient temperature is below thirty-two (32) degrees Fahrenheit with a rising or falling temperature, or when there is a probability of such a condition existing within forty-eight (48) hours, unless special provisions are made for heating the materials and protecting the work from freezing. Work will not be permitted with or on frozen materials. Use of bricks having a film of frost on their surfaces will not be permitted.

3.02 INSTALLATION

A. General

1. Build chases and recesses as shown or required by others. Provide not less than eight (8) inches of brick masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

2. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting of brickwork construction. After installation of said items, complete brickwork construction to match work immediately adjacent to openings.

3. Use full size units without cutting wherever possible. Provide special exterior brick shapes for all transitions and intersections. Do not field-cut special shapes from regular exterior brick shapes or substitute other alternatives for the use of special exterior brick shapes.

4. Coursing: Brick shall be carried up level and plumb all around. Do not carry up one section of the walls in advance of the others, unless specifically approved. Heights of brickwork shall be checked with an instrument at each floor, and at sills and heads of openings, to maintain the level of walls. Brick courses shall be maintained to a uniform dimension. Vertical and horizontal joints shall be formed to a uniform thickness. Bricks shall be laid to match the existing adjacent bond. Mortar joints shall be tooled to be concave.

5. Placing and Bonding: Clay masonry units shall be placed in a full bed of mortar, with full head joints, and shall be uniformly jointed with other Work.

a. Mortar Removal: Excess mortar shall be removed as the installation progresses.

b. Corners and Intersections: Intersections and external corners shall be interlocked. Horizontal reinforcing shall be spliced at intersections and corners with a 6-inch overlap of side rods.

c. Adjustment: Do not shift or tap bricks after mortar has achieved initial set. Where adjustment must be made, mortar shall be removed and replaced with new mortar.

d. Cutting: Job site cutting of exposed bricks shall be performed with power masonry saws to provide straight, clean, unchipped edges. . Broken masonry unit corners or edges shall not be allowed.

e. Placing Metalwork: Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels and miscellaneous metalwork specified in other Sections, shall be placed and built into position as the installation progresses.

f. Bonding and Anchoring: Walls shall be structurally bonded or anchored to each other and to concrete walls, beams, columns, and wall and roof diaphragms. Nonload-bearing shall be anchored to construction above in a manner that provides appropriate lateral stability and vertical movement of floor and roof construction above.

g. Preparation for New Work: Unfinished brickwork shall be stepped back for joining with new brickwork. Toothing will not be permitted.

6. Weeps and Mortar Nets: Weep holes shall be installed in veneer at bottom of walls at spacing indicated on the Contract Drawings or specified in the Contract. Mortar nets shall be installed at bottom of cavities to maintain open weeps.

7. Horizontal Joint Reinforcement and Anchorages: Horizontal joint reinforcement and anchorages shall be constructed as follows:

a. Reinforcement Spacing: Horizontal joint reinforcement shall be spaced at a minimum of sixteen (16) inches on center, measured vertically.

b. Reinforcement Placing: Masonry joint reinforcement shall be placed in the first horizontal joint above and below openings. Reinforcement shall be extended a minimum of sixteen (16) inches on each side of openings. Joint reinforcement shall be placed continuously in the first joint below the top of all walls. Joint reinforcement ends shall be lapped a minimum of six (6) inches. Joints at corners and intersections shall be reinforced with strap anchors at sixteen (16)-inch centers.

c. Veneer Anchorage: Dovetail anchorage shall be provided in concrete for bonding veneer at a maximum of sixteen (16)-inch

centers vertically and horizontally. Anchors shall be placed within 8 inches of all openings.

8. Waterproofing Course: A waterproofing course of flashing as specified in Section 07 62 00 - Sheet Metal Flashing and Trim, and as shown on the Contract Drawings, and at the following locations: at the bottom of brick walls, at points where roofs adjoin exterior brick walls, at lintels, below louver sills and window sills, and at other locations shown on the Contract Drawings.

   a. Surface Condition: Surfaces to receive waterproofing course shall be smooth, dry, and free from loose material before applying the waterproofing course.

   b. Application: Flashing shall project two (2) inches from the outside face of the wall and shall be built into the walls as indicated. Flashing shall extend a minimum of eight (8) inches beyond the line of the jamb, with the ends turned up two (2) inches to form a pan at the heads and sills of louver and window openings, and at the heads of door openings.

9. Control Joints: Preformed control joint material shall be installed in continuous lengths. Butt and corner joints shall be sealed in accordance with manufacturer's instructions. Control joints shall be sized as indicated on the Contract Drawings. Horizontal joint reinforcement shall not continue through control joints.

10. Built-In Work: Metal door and window frames, fabricated metal frames, louvered openings, anchor bolts, pipes, ducts, conduits, plates and items specified in other Sections shall be built in as the Work progresses. Items shall be built in plumb and level. . Do not build in organic materials subject to deterioration.

11. Tolerances: Brickwork shall meet the tolerances specified in ACI 530.1/ASCE 6-95/TMS 602.

12. Cutting and Fitting: Brickwork shall be cut and fit for chases, pipes, conduit, sleeves, grounds, and other items specified elsewhere. The Work shall be coordinated to provide correct size, shape, and location.

B. Laying Brick Walls, General

1. Mortar Types: Unless otherwise indicated, use mortar as specified in Section 04 05 00 – Common Work Results for Masonry and as follows:

   a. Use Type S mortar for all exterior walls.

   b. Use grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction.

   c. Do not use mortar which has begun to set or if more than two (2) hours have elapsed since initial mixing. Retemper mortar during the two (2)-hour period only as required to restore workability.

2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns and offsets. Avoid the use of less than half size bricks at corners, jambs and wherever possible at other locations.

3. Lay-up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other Work.

4. Mortar Color and Texture:

   a. Lay all brick masonry using mortar colors selected by Engineer at time of sample panel erection.

C. .Face Brick

1. Bond: Brickwork shall be laid in the same bond, pattern as that of the existing brickwork adjacent to the sections being rebuilt.

2. Joints: All joints between bricks shall be completely filled with mortar. Bed joints shall comprise a thick layer of mortar, smoothed or furrowed lightly. Head joints shall be formed by applying, to the brick to be laid, a full coat of mortar on the entire end, or on the entire side, as the case requires, and then shoving the mortar-covered end or side of the brick tightly against the brick laid previously.

3. Closure Brick: Closure brick shall be laid with a bed joint and with head joints. Brick shall be carefully placed so as not to disturb the brick previously laid.

4. Test: Clay or shale brick shall be tested daily on the job, prior to laying, to determine if they will require wetting.

D. Cavity Walls

1. Construction: Cavity walls shall be constructed using a masonry backing separated from a brick exterior wythe by a continuous air space and insulation as indicated. The two (2) wythes shall be securely tied together with a seismic horizontal joint reinforcement system, placed as indicated.

2. Insulation: Insulation board shall be secured to the backup construction using insulation clip washers as specified to hold the insulation in place. The insulation board shall be job fabricated as necessary, using a knife or saw, to fit around obstructions, such as reinforcing and vents. Joints between the obstructions and the insulation shall be sealed with mastic. All joints in the insulation shall be shoved tight. Insulation shall be installed in strict compliance with the manufacturer's recommendations.

3. Cavity: The space between the wythes shall be kept clear and clean of mortar droppings by use of wood strips, slightly narrower than the cavity, laid on horizontal reinforcing. The wood strips shall be lifted out and cleaned when horizontal joint reinforcing is placed. Mortar shall not be allowed to drop into cavity while cleaning wood strips. Weep holes shall be provided at the base of the wall cavity, where the cavity is closed over with

masonry or flashing, and at other locations as indicated. A continuous mortar net shall be set on top of the base flashing.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

B. Protection

1. Protection of Finished Work: Protective boards shall be provided at exposed external corners susceptible to damage by construction activities, without damaging completed Work.

2. Remove and replace bricks that are loose, chipped, broken, stained or otherwise damaged, or if bricks do not match adjoining units as intended. Provide new bricks to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

3. At all times, surfaces of brickwork on which Work is not being performed shall be protected. When rain or snow is imminent and Work is discontinued, tops of exposed brickwalls and similar surfaces shall be covered with a strong waterproof membrane, well secured in place.

C. Cleanup

1. General: After mortar has set, new brickwork shall be cleaned as follows:

a. All brickwork: All excess mortar and mortar smears shall be removed. Any defective mortar shall be removed and replaced, matching adjacent work. Nonmetallic tools shall be used in all cleaning operations.

b. Brick: Brickwork, other than glazed brick, shall be cleaned using a solution comprising 1-part commercial grade muriatic acid and 9 parts water, cleaning areas not exceeding ten (10) to twenty (20) square feet at a time. Area to be cleaned shall be soaked with water, then scrubbed with the acid solution, followed by a rinse with clean water. Fiber brushes shall be used to apply the acid solution and to wash the brickwork. Do not allow the acid solution to come in contact with metalwork. Brickwork and stonework below the area being cleaned shall be kept wet during the cleaning process.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Unit masonry as specified herein includes, but is not limited to, face brick, structural glazed brick, concrete masonry units, ground face concrete masonry units, glazed structural tile, reinforcement, anchorage, and all accessories and appurtenances.

B. Unit masonry shall be provided as indicated on the Contract Drawings, specified herein, or as required for a complete installation.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	16
3.05	Adjusting / Protection / Cleanup	16

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 04 05 00 - Common Work Results for Masonry

B. Section 05 50 00 - Metal Fabrications

C. Section 07 62 00 - Sheet Metal Flashing and Trim

1.04 REFERENCES

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C. ASTM C90 - Standard Specification for Load-Bearing Concrete Masonry Units

D. ASTM C126 - Standard Specification for Ceramic glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

E. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale)

F. Masonry Standards Joint Committee (MSJC):

1. TMS 402/ACI 530/ASCE 5 - Building Code Requirements for Masonry Structures

2. TMS 602/ACI 530.1/ASCE 6 - Specification for Masonry Structures

G. New York City Building Code Section BC 2103 Masonry Construction Materials, BC 2104 Construction

1.05 DESCRIPTION

A. Provide masonry accessories of sizes, dimensions and configurations coordinated with unit masonry construction system component sizes, dimensions and configurations.

B. Where continuous horizontal cavity wall reinforcement is specified as providing restraint for cavity wall insulation, coordinate dimensions with thickness of cavity wall insulation specified for proper clearances.

C. Where structural steel will be provided with fireproofing do not use welded-on channel slots. Coordinate required offset of welded-on wire ties with depth of fireproofing.

D. Concrete Masonry Units: Limit total moisture absorption until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the United States Weather Bureau Station nearest the Site and the corresponding percentage of total linear drying shrinkage of the concrete masonry units.

E. Comply with ASTM C90 Climatic Map establishing criteria for percent annual mean relative humidity.

F. Structural elements of masonry shall conform to the requirements of TMS 402/ ACI 530/ASCE 5 for materials and installation.

G. Masonry materials and installation shall conform to the requirements of TMS 602/ACI 530.1/ASCE 6.

H. Sustainable Design Requirements:

1. Recycled Content of Unit Masonry: Postconsumer recycled content plus one-half of preconsumer recycled content not less than fifteen (15) percent.

2. Regional Materials: Unit Masonry shall be manufactured within five hundred (500) miles of Project Site, from materials that have been extracted, harvested, or recovered within five hundred (500) miles of Project Site.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-hour and similar designations), provide masonry accessories, masonry units and unit masonry construction complying with the requirements established by UL and other governing authorities having jurisdiction at the Project Site.

B. Source Quality Control: Provide all metal sheet, wire, plate and bar stock masonry accessories from the same manufacturer.

C. Sample Panel: The Contractor shall erect a composite four (4) feet long by three (3) feet high sample panel.

1. The sample panel shall include facing veneer, bond pattern, mortar color, tooled joints, insulation, reinforcing, and backup.

2. Upon approval, the sample panel shall remain in place for the duration of masonry construction and shall be used as a basis of comparison for all masonry work.

3. After final approval of finished masonry work by the Engineer, the Contractor shall demolish the sample panel, and shall perform all Site restoration work.

4. Masonry work shall not be started until the specified sample panel has been approved. The sample panel shall be used as a standard for comparison of masonry work. Sample panel shall be destroyed only after all masonry work has been completed and approved by the Engineer.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and other material for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Catalog cuts, drawings and reference materials.

2. Samples: The Contractor shall submit three samples each of face brick, structural glazed brick, glazed structural tile and decorative concrete masonry units that are representative of the full range of color, shading and texture of the material to be provided.

3. Test Reports: The Contractor shall submit material test reports or manufacturer's certificate of compliance for face brick, structural glazed brick, concrete masonry units, and glazed structural tile.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer’s specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements.

2. Provide drawings and material schedules showing all dimensions and sizes of masonry accessories coordinated with unit masonry construction work, and other work in which masonry accessories will be embedded, be supported from, or restrain.

3. Indicate methods for identifying and coordinating, at the Site, the location and accurate placement of each masonry accessory in unit masonry construction as the Work progresses. Indicate by letter of transmittal that items which must be installed in the shop have been received in time for proper sequencing of the Work to avoid delays.

4. Explanation of where each masonry accessory will be used in the Work, quantities purchased and intended spacings indicating compliance with code requirements.

5. Complete layout of all glazed structural tile and filled ground face unit masonry walls showing modular planning and all special shapes to be used in the work. Show all details for each condition encountered in the Work. Provide plan and elevation views drawn at 1/4-inch scale and details drawn at 1-1/2-inch scale. Show all items required to be built into unit masonry construction.

6. Masonry control joint locations and details.

7. Drawings showing the location, extent and accurate configuration and profile of all items shown, specified and required by this and other Sections to be built into the unit masonry construction as the work progresses. Provide elevations drawn at 1/4-inch scale and all details drawn at 1-1/2-inch scale.

8. Drawings for fabrication, bending, and placement of reinforcing bars. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for unit masonry construction.

C. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content and Regional Materials. Provide the following information:
    a. Name of Product and Manufacturer.
    b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).
    c. The percentage (by weight) of post-consumer and pre-consumer recycled content for the submitted product.
    d. Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: All products and materials shall be delivered, stored, and handled as follows.

B. Delivery and Storage: Masonry materials delivered and stored at the Site shall be from approved manufacturers and sources only.

C. Masonry Units:
1. Masonry units shall be handled in a manner which prevents undue breakage or chipping.
2. Face brick and concrete masonry units shall be unloaded using brick clamps.
3. All masonry units shall be stored on platforms under shelter or in another approved manner so as to protect these materials from soil and weather.

D. Rejection: Face bricks, structural glazed bricks, glazed structural tile, concrete masonry units, and ground face concrete masonry units that are warped, cracked or of inferior quality will be rejected. Such items shall be removed from the site and not offered again for inspection.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers of unit masonry items shall be:
1. Belden Brick Company:

Canton, Ohio

2. Consolidated Brick
Avon, MA

3. Elgin Butler Company
Elgin, Texas

4. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Face Brick: Face brick shall conform to ASTM C216 Grade SW Type FBX.

B. Structural Glazed Brick: Structural glazed brick shall meet the requirements of ASTM C126 for finish properties and shall conform to ASTM C216 Grade SW Type FBX for durability. Structural glazed brick shall meet UL requirements for zero flame spread and zero smoke developed. Structural glazed brick shall match the existing buff or dark green color of the surrounding glazed brick, and the size will match that of the existing material as well.

C. Concrete Masonry Units: Concrete masonry units shall be manufactured with lightweight aggregate and shall be provided as follows:

1. Hollow Load-Bearing Units: Hollow load-bearing units shall conform to ASTM C90, Type I for exterior walls, foundation walls, interior load-bearing and nonload-bearing walls and partitions. Units shall have a compressive strength of three thousand (3,000) psi over the net area.

2. Solid Load-Bearing Units: Solid load-bearing units shall conform to ASTM C90, Type I, except units exposed to weather shall be Grade U. Solid units shall be provided for masonry bearing under structural framing members and for fireproofing of steel structural members. Units shall have a compressive strength of three thousand (3,000) psi over the net area.

3. Special Shapes: Special shapes, such as closures, header units, and jamb units shall be provided as necessary to complete the work. Special shape units shall conform to the applicable provisions for the units with which they are used.

D. Glazed Structural Tile: Glazed structural facing tile shall be of Selected Size Quality (Grade SS ground ends) in size as specified in the Contract, and shall conform to the requirements of ASTM C126, Type I. Glazed structural tile walls and partitions shall be provided with bullnose shapes for external corners, sills, and jambs, and shall have coved base courses.

E. Metal Accessories:

1. For interior walls and partitions, and as required to secure masonry to adjoining construction, the Contractor shall provide hot-dipped galvanized metal anchors, ties and reinforcements conforming to ASTM A153/A153M, Class B2 that are galvanized after cutting.

2. For exterior walls, the Contractor shall provide Type 316 stainless steel for anchors, anchor slots, ties and horizontal reinforcement.

F. Deformed reinforcing bars shall conform to ASTM A615/A615M Grade 60.

G. Horizontal Joint Reinforcement: Horizontal reinforcing shall be two (2) inches less in width than the actual thickness of the wall or partition in which it is to be placed.

1. Solid interior or exterior masonry walls: Walls shall be reinforced horizontally with truss type, standard 9 gauge (.148-inch) by 9 gauge (.148-inch). Reinforcing shall be spaced at 16-inch centers vertically.

2. Exterior Cavity Walls: Walls shall be reinforced horizontally with truss type 9 gauge (.148-inch) by 9 gauge (.148-inch) reinforcing in the inner wythe with rectangular pintle and seismic clip to continuous 9 gauge wire reinforcing in the outer wythe. Reinforcing system shall include insulation clip washers. Reinforcing shall be spaced at a minimum of sixteen (16)-inch centers vertically.

3. Corners: Corners shall be reinforced with the same type as wall reinforcing, standard 9 gauge (.148 inch) by 9 gauge (.148-inch), spaced in the same course as the wall reinforcing.

4. Intersections: Intersections between walls and partitions shall be reinforced horizontally with same type as wall reinforcing, standard 9 gauge (.148-inch) by 9 gauge (.148-inch), spaced in the same course as the wall reinforcing.

H. Rebar Positioners: The Contractor shall provide vertical and horizontal rebar positioners spaced at forty-eight (48)-inch centers maximum.

I. Dovetail Anchors: Dovetail anchors shall be 1/8-inch by 1-inch by 2-inch with 3/16-inch diameter wire.

J. Rigid Anchors: Rigid steel anchors shall be 1 inch wide (minimum), 3/16 inch thick, and 18 inches long between bent ends. Each end shall be bent down 3 inches (minimum) into mortar filled masonry cells.

K. Column Anchors: Masonry shall be anchored to columns at twenty-four (24)-inch centers with stainless steel anchors.

L. Metal Fastenings: Bolts, metal wall plugs or other approved metal fastenings for securing items to masonry and elsewhere shall be provided and installed as necessary.

M. Weep Holes: Weep holes shall be provided where shown, and shall consist of clear polyethylene, medium density plastic, rectangular tubes, 3/8 inch wide, 1-1/2 inches high, 3-1/2 inches deep.

N. Weep Vents: Weep vents shall be provided where shown, and shall be an offset T-shaped vent injection molded from flexible polyvinyl chloride. The vents shall be provided in a custom size and color to match brick and mortar as specified in the Contract.

O. Mortar Net: Mortar net shall be of high density polyethylene and shall be one inch nominal thickness.

P. Mortar Materials: Mortar materials shall be in accordance with Section 04 05 00 – Common Work Results for Masonry.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

1. Environmental Conditions: Materials and surrounding air temperature shall be maintained at a minimum fifty (50) degrees Fahrenheit prior to, during, and seventy-two (72) hours after completion of masonry work. Masonry shall not be erected when the ambient temperature is below thirty-two (32) degrees Fahrenheit with a rising or falling temperature, or when there is a probability of such a condition existing within forty-eight (48) hours, unless special provisions are made for heating the materials and protecting the work from freezing. Work will not be permitted with or on frozen materials. Use of masonry units having a film of frost on their surfaces will not be permitted.

3.02 INSTALLATION

A. General

1. Build chases and recesses as shown or required by others. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

2. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting of unit masonry construction. After installation of said items, complete unit masonry construction to match work immediately adjacent to openings.

3. Use full size units without cutting wherever possible. Provide special unit masonry shapes for all transitions and intersections. Do not field-cut special shapes from regular unit masonry shapes or substitute other alternatives for the use of special unit masonry shapes.

4. Build interior masonry walls, visible from both sides in the finished work, using two wythes of masonry. Glazed structural tile and filled ground face masonry units shall be continuous over the entire plan of the wall including walls which continue behind fixtures, equipment, furniture, lockers and similar items.

5. Coursing: Masonry walls shall be carried up level and plumb all around. Do not carry up one section of the walls in advance of the others, unless specifically approved. Heights of masonry shall be checked with an instrument at each floor, and at sills and heads of openings, to maintain the level of walls. Masonry courses shall be maintained to a uniform dimension. Vertical and horizontal joints shall be formed to a uniform thickness. Concrete masonry units shall be laid in running bond. One unit and one mortar joint shall be coursed to equal eight (8) inches. Mortar joints shall be tooled to be concave.

6. Placing and Bonding: Solid masonry units shall be placed in a full bed of mortar, with full head joints, and shall be uniformly jointed with other Work.

    a. Mortar Removal: Excess mortar shall be removed as the installation progresses.

    b. Corners and Intersections: Intersections and external corners shall be interlocked. Horizontal reinforcing shall be spliced at intersections and corners with a six (6)-inch overlap of side rods.

    c. Adjustment: Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, mortar shall be removed and replaced with new mortar.

    d. Cutting: Job Site cutting of exposed masonry units shall be performed with power masonry saws to provide straight, clean, unchipped edges. All glazed brick and glazed structural tile shall be cut using a continuous rim wet cutting diamond blade suitable for cutting these material types. Broken masonry unit corners or edges shall not be allowed.

    e. Flush Joints: Mortar joints shall be cut flush where ceramic wall tile is to be installed.

    f. Control Joints: Nonload-bearing masonry partitions shall be isolated from vertical and horizontal structural framing members with control joints.

    g. Placing Metalwork: Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels and miscellaneous metalwork specified in other Sections, shall be placed and built into position as the installation progresses.

    h. Extent of Masonry: Masonry partitions and walls shall extend from the floor to the bottom of floor or roof construction above, unless otherwise indicated.

    i. Bonding and Anchoring: Walls and partitions shall be structurally bonded or anchored to each other and to concrete walls, beams, columns, and wall and roof diaphragms. Nonload-bearing walls and partitions shall be anchored to construction above in a manner that

provides appropriate lateral stability and vertical movement of floor and roof construction above.

j. Preparation for New Work: Unfinished masonry shall be stepped back for joining with new masonry. Toothing will not be permitted.

7. Weeps and Mortar Nets: Weep holes shall be installed in veneer at bottom of walls at spacing indicated on the Contract Drawings or specified in the Contract. Mortar nets shall be installed at bottom of cavities to maintain open weeps.

8. Horizontal Joint Reinforcement and Anchorages: Horizontal joint reinforcement and anchorages shall be constructed as follows:

a. Reinforcement Spacing: Horizontal joint reinforcement shall be spaced at a minimum of sixteen (16) inches on center, measured vertically.

b. Reinforcement Placing: Masonry joint reinforcement shall be placed in the first horizontal joint above and below openings. Reinforcement shall be extended a minimum of sixteen (16) inches on each side of openings. Joint reinforcement shall be placed continuously in the first joint below the top of all walls. Joint reinforcement ends shall be lapped a minimum of six (6) inches. Joints at corners and intersections shall be reinforced with strap anchors at sixteen (16)-inch centers.

c. Veneer Anchorage: Dovetail anchorage shall be provided in concrete for bonding veneer at a maximum of sixteen (16)-inch centers vertically and horizontally. Anchors shall be placed within eight (8) inches of all openings.

9. Waterproofing Course: A waterproofing course of flashing as specified in Section 07 62 00 - Sheet Metal Flashing and Trim, and as shown on the Contract Drawings, and at the following locations: at the bottom of masonry walls, at points where roofs adjoin exterior masonry walls, at lintels, below louver sills and window sills, and at other locations shown on the Contract Drawings.

a. Surface Condition: Surfaces to receive waterproofing course shall be smooth, dry, and free from loose material before applying the waterproofing course.

b. Application: Flashing shall project two (2) inches from the outside face of the wall and shall be built into the walls as indicated. Flashing shall extend a minimum of eight (8) inches beyond the line of the jamb, with the ends turned up two (2) inches to form a pan at the heads and sills of louver and window openings, and at the heads of door openings.

10. Control Joints: Preformed control joint material shall be installed in continuous lengths. Butt and corner joints shall be sealed in accordance with

manufacturer's instructions. Control joints shall be sized as indicated on the Contract Drawings. Horizontal joint reinforcement shall not continue through control joints.

11. Built-In Work: Metal door and window frames, fabricated metal frames, louvered openings, anchor bolts, pipes, ducts, conduits, plates and items specified in other sections shall be built in as the work progresses. Items shall be built in plumb and level. Frame voids shall be filled solid with grout. Adjacent masonry cores shall be filled with grout for a minimum of 12 inches beyond the framed openings. Do not build in organic materials subject to deterioration.

12. Tolerances: Masonry work shall meet the tolerances specified in ACI 530.1/ASCE 6-95/TMS 602.

13. Cutting and Fitting: Masonry shall be cut and fit for chases, pipes, conduit, sleeves, grounds, and other items specified elsewhere. The Work shall be coordinated to provide correct size, shape, and location.

B. Laying Masonry Walls, General

1. Mortar Types: Unless otherwise indicated, use mortar as specified in Section 04 05 00 – Common Work Results for Masonry and as follows:

   a. Use Type M mortar for all structural reinforced masonry walls.

   b. Use Type S mortar for all exterior and all load-bearing walls.

   c. Use Type N mortar for all interior non-load-bearing walls.

   d. Use epoxy pointing mortar for all glazed structural tile and all filled ground face concrete masonry unit joints.

   e. Use grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction.

   f. Do not use mortar which has begun to set or if more than two (2) hours have elapsed since initial mixing. Retemper mortar during the two (2)-hour period only as required to restore workability.

2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible at other locations.

3. Lay-up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other Work.

4. Mortar Color and Texture:

   a. Lay all concrete unit masonry using mortar of natural color.

   b. Lay all glazed structural tile and filled ground face concrete unit masonry work using mortar of natural color. Rake as specified to receive pointing mortar.

c. Lay all structural glazed brick using mortar colors selected by Engineer at time of sample panel erection.

5. Hand select glazed structural tile and ground face masonry units to assure uniform continuity of finished surfaces from unit to unit. Glazed structural tile with misaligned face ceramic glazing shall be permanently removed from the Site.

C. Face Brick

1. Bond: Brickwork shall be laid in common bond, unless indicated otherwise on the Contract Drawings or in the Contract.

2. Joints: All joints between bricks shall be completely filled with mortar. Bed joints shall comprise a thick layer of mortar, smoothed or furrowed lightly. Head joints shall be formed by applying, to the brick to be laid, a full coat of mortar on the entire end, or on the entire side, as the case requires, and then shoving the mortar-covered end or side of the brick tightly against the brick laid previously.

3. Closure Brick: Closure brick shall be laid with a bed joint and with head joints. Brick shall be carefully placed so as not to disturb the brick previously laid.

4. Test: Clay or shale brick shall be tested daily on the job, prior to laying, to determine if they will require wetting.

D. Structural Glazed Brick

1. Bond: Structural glazed brick shall be laid in bond as indicated on the Contract Drawings and as specified in the Contract.

2. Joints: All joints between bricks shall be completely filled with mortar. Bed joints shall comprise a thick layer of mortar, smoothed or furrowed lightly. Head joints shall be formed by applying, to the brick to be laid, a full coat of mortar on the entire end, or on the entire side, as the case requires, and then shoving the mortar-covered end or side of the brick tightly against the brick laid previously.

3. Joint Treatment: Mortar joints shall be tooled or struck when they are thumb print hard. All mortar joints in structural glazed brick shall be tooled concave using a non-metallic tool of a size as specified in the Contract.

4. Special Joints: Special joints in structural glazed brick shall consist of control joints, which shall be constructed as detailed and specified, and accent joints, which shall have mortar raked back two (2) inches, and shall then be caulked to match the appearance of control joints. Control and accent joints shall be installed where shown on the Contract Drawings.

5. Weep and Mortar Nets: Provide rows of weep vents in the head joints of the first and third courses of masonry immediately above all concealed flashings. Space weep vents sixteen (16) inches on centers horizontally. Provide rows eight (8) inches on center vertically. Stagger rows.

6. Horizontal Joint Reinforcement and Anchorages

   a. Reinforcement Spacing: Continuous horizontal joint reinforcement shall be spaced as follows:

      1) For multi-wythe walls, solid or cavity, where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by governing authorities having jurisdiction at the Project Site, but not more than twenty-four (24)-inches on centers, vertically.

      2) For single wythe walls, space reinforcing at sixteen (16) inches on centers vertically.

      3) For parapets, space reinforcing at eight (8) inches on centers vertically for large square structural glazed brick.

7. Reinforce all walls with continuous horizontal joint reinforcement unless specifically noted or specified to be omitted.

8. Waterproofing Course:

   a. Application: Flashing shall terminate flush with outside face of walls and shall be built into the walls as indicated. Flashing shall extend a minimum of eight (8) inches beyond the line of the jamb, with the ends turned up two (2) inches to form a pan at the heads and sills of louvers and window openings, and at the heads of door openings in masonry.

   b. Place through-wall flashing on bed of mortar and cover with mortar.

   c. Interlock metal 3-way sawtooth flashings and overlap at seams as recommended by the manufacturer, with minimum lap of four (4) inches.

9. Lintels and Bond Beams

   a. Provide stainless steel lintels where shown and as specified in Section 05 50 00 - Metal Fabrications.

   b. Provide masonry lintels and bond beams where shown and wherever openings of sixten (16) inches or more are shown without structural stainless steel lintels. Provide formed-in-place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.

      1) Unless otherwise shown, provide one horizontal No. 6 deformed reinforcing bar for each four (4) inches of wall thickness.

      2) For hollow masonry unit walls, use specially formed AU@ shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout as specified in Section 04 05 00 – Common Work Results Masonry.

c. Provide minimum bearing at each jamb, of four (4) inches for openings less than six (6) feet wide, and eight (8) inches for wider openings.

d. On concrete and clay unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain continuity of joint pattern of wall and install to be indistinguishable from surrounding masonry.

10. Collar Joints: Fill the vertical space between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging, for all exterior multi-wythe walls (except do not fill cavity of cavity wall construction) and interior multi-wythe walls and partitions.

11. Structural Glazed Brick Bond: Structural glazed brick shall be laid in bond patterns as follows:

a. Norman (6S Series): 1/3 running bond; four (4)-inch nominal offset between courses above and below.

b. Large Squares (6Y Series): Stacked bond; vertical joints in each course aligned with joints in course above and below.

E. Concrete Masonry Units

1. Bed and Head Joints: The first course of concrete masonry units shall be laid in a full bed of mortar for the full width of the unit. Bed joints of concrete masonry units shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells, and head joints shall be formed by applying the mortar for a width of about one (1) inch to the ends of the adjoining units laid previously. Joints shall be mortared smooth, not furrowed, and of such thickness that mortar will be forced out of the joints as the units are being placed in position. Where anchors, bolts, reinforcing and ties occur within the cells of the units, such cells shall be filled solid with grout as the work progresses.

2. Concrete Brick: Concrete brick shall be used for topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as indicated.

3. Unit Condition: Concrete masonry units shall be placed dry with no previous wetting.

F. Glazed Structural Tile

1. Glazed Structural Tile: Glazed structural tile shall be installed in accordance with the general requirements for masonry installation specified herein. Mortar joints in glazed structural tile walls shall be raked back a minimum of 1/4 inch, allowed to cure for a minimum of twenty-four (24) hours, and then shall be pointed using an epoxy grout as specified in Section 04 05 00 – Common Work Results for Masonry.

G. Cavity Walls

1. Construction: Cavity walls shall be constructed using a masonry backing separated from a masonry exterior wythe by a continuous air space and insulation as indicated. The two wythes shall be securely tied together with a seismic horizontal joint reinforcement system, placed as indicated.

2. Insulation: Insulation board shall be secured to the backup construction using insulation clip washers as specified to hold the insulation in place. The insulation board shall be job fabricated as necessary, using a knife or saw, to fit around obstructions, such as reinforcing and vents. Joints between the obstructions and the insulation shall be sealed with mastic. All joints in the insulation shall be shoved tight. Insulation shall be installed in strict compliance with the manufacturer's recommendations.

3. Cavity: The space between the wythes shall be kept clear and clean of mortar droppings by use of wood strips, slightly narrower than the cavity, laid on horizontal reinforcing. The wood strips shall be lifted out and cleaned when horizontal joint reinforcing is placed. Mortar shall not be allowed to drop into cavity while cleaning wood strips. Weep holes shall be provided at the base of the wall cavity, where the cavity is closed over with masonry or flashing, and at other locations as indicated. A continuous mortar net shall be set on top of the base flashing.

H. Reinforced Masonry

1. Setting Masonry: Masonry for vertically reinforced masonry units shall be laid with core cells vertically aligned. Core cells shall be clear of mortar and unobstructed. Mortar shall be placed in masonry unit bed joints and shall be back 1/4 inch from the edge of the unit grout spaces, and beveled back and upward. Mortar shall be cured seven (7) days before placing grout.

2. Reinforcing: Concrete masonry unit cores shall be reinforced with reinforcement bars and grout as shown. Vertical reinforcement shall be kept in position using rebar positioners at top and bottom of cells and at intervals not exceeding forty-eight (48) inches. Reinforcement shall be spliced in accordance with ACI 530/ASCE 5-95/TMS 402, but splice lap shall be not less than twenty-four (24) bar diameters.

3. Grouting: Masonry unit surfaces in contact with grout shall be wetted just prior to grout placement. Spaces less than two (2) inches in width shall be grouted with fine grout using low lift grouting techniques. Spaces two (2) inches or greater in width shall be grouted with coarse grout using high or low lift grouting techniques. When grouting is stopped for more than one (1) hour, grout shall be terminated 1-1/2 inches below top of upper masonry unit to form a positive key for subsequent grout placement.

4. Low Lift Grouting: The first lift of grout shall be placed to a height of sixteen (16) inches and then shall be rodded for grout consolidation. Subsequent lifts shall be placed in eight (8)-inch increments and rodded for grout consolidation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

B. Protection

1. Protection of Finished Work: Protective boards shall be provided at exposed external corners susceptible to damage by construction activities, without damaging completed Work.

2. Remove and replace masonry units that are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

3. At all times, surfaces of masonry on which Work is not being performed shall be protected. When rain or snow is imminent and Work is discontinued, tops of exposed masonry walls and similar surfaces shall be covered with a strong waterproof membrane, well secured in place.

C. Cleanup

1. General: After mortar has set, new masonry work shall be cleaned as follows:

a. All masonry: All excess mortar and mortar smears shall be removed. Any defective mortar shall be removed and replaced, matching adjacent work. Nonmetallic tools shall be used in all cleaning operations.

b. Structural Glazed Brick, Concrete Masonry, Ground Face Concrete Masonry Units, and Glazed Structural Tile: Units shall be washed with clean water and soap powder using soft fiber brushes.

c. Brick: Brickwork, other than glazed brick, shall be cleaned using a solution comprising one (1)-part commercial grade muriatic acid and nine (9) parts water, cleaning areas not exceeding ten (10) to twenty (20) square feet at a time. Area to be cleaned shall be soaked with water, then scrubbed with the acid solution, followed by a rinse with clean water. Fiber brushes shall be used to apply the acid solution and to wash the brickwork. Do not allow the acid solution

to come in contact with metalwork. Brickwork and stonework below the area being cleaned shall be kept wet during the cleaning process.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Stone masonry repair and replacement units as specified herein include, but are not limited to, limestone, reinforcement, anchorage, and all accessories and appurtenances.

B. Stone repair and replacement masonry unit items shall be provided as required in the Contract Drawings and Specifications and as required for a complete installation.

C. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 04 05 00 - Common Work Results for Masonry

B. Section 07 90 00 - Joint Protection

1.04 REFERENCES

A. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

B. ASTM C99 - Standard Test Method for Modulus of Rupture of Dimension Stone

C. ASTM C170 - Standard Test Method for Compressive Strength of Dimension Stone

D. ASTM C568 - Standard Specification for Limestone Dimension Stone

1.05 DESCRIPTION

A. Removal and replacement of deteriorated and damaged exterior stone at doors, windows, parapet caps, thresholds and steps included for the Work of this Section will be provided in the Contract, if necessary, to supplement the requirements given herein or in the Contract Drawings.

1.06 QUALITY ASSURANCE

A. Engage an experienced stone repair firm to perform Work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repair work.

B. Field Supervision: Stone repair specialist firms shall maintain experienced full-time supervisors on Project Site during times that stone repair work is in progress.

C. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

D. Stone masonry unit materials and installation shall conform to the requirements of ASTM C568.

E. Sample Panel Mockups: The Contractor shall erect composite sample panel mockups to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Sample panel mockups are to include samples representative of each item which will be incorporated into the Work. The Contractor shall install sample panels of size and at locations approved by Engineer as required to demonstrate quality of materials, workmanship, and blending with existing Work.

1. The sample panel shall include elements typical of the stonework on this Project.
2. Upon approval, the sample panel shall remain in place for the duration of stone masonry unit construction and shall be used as a basis of comparison for all stone masonry unit work.
3. After final approval of finished stone masonry unit work by the Engineer, the Contractor shall demolish the sample panel, and shall perform all Site restoration work.

1.07 SUBMITTALS

A. The Contractor shall prepare and submit Shop Drawings and reference materials for approval of the Engineer. Submittals shall include, but not be limited to the following:

1. Qualification Data: For stone repair specialist, including field supervisors.
2. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.
3. Samples: The Contractor shall submit three (3) 12-inch square samples of stone that are representative of the full range of color, grain, veining and texture of the material to be provided. The Contractor shall submit Colored Mortar samples: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels. The Contractor shall submit Patching Compound samples: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of stone representative of the range of stone colors on the building.
4. Shop Drawings: The Contractor shall submit cutting and setting drawings indicating sizes, dimensions, sections and profiles of stones, along with arrangement and provisions for jointing, supporting, anchoring, and bonding stonework. Shop Drawings shall include relationship with, attachment to, and reception of all related Work.
5. Test Reports: The Contractor shall submit material test reports of tests performed on stone masonry units in accordance with ASTM C99 for Modulus of Rupture and ASTM C170 for Compressive Strength. Test each proposed type of replacement stone according to ASTM C170/C170M for compressive strength, ASTM C99/C99M for modulus of rupture, and ASTM C97/C97M for absorption and bulk specific gravity.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Stone masonry unit materials delivered and stored at the site shall be from approved manufacturers and sources only.

3. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. All stone masonry units shall be stored on non-staining wood skids or pallets under shelter, or covered with non-staining waterproof membrane so as to protect these materials from soil and weather.

3. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Project Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled in such a way to avoid damage or breakage.

2. Stone masonry units shall be lifted using wide-belt slings. Pinch bars, wrecking bars, wire ropes, or ropes containing tar or other substances which might cause staining or damage shall not be used.

3. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be permanently removed from the Project Site and shall not be incorporated into the Work.

4. Materials shall be handled in such a manner so as to prevent inclusion of foreign materials.

5. Packages or containers shall not be opened until all necessary preparatory work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

6. Rejection: Stone masonry units that are warped, cracked or of inferior quality will be rejected. Such items shall be removed from the Site and not offered again for inspection.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coldspring Co., Cold Spring, MN;

B. Independent Limestone Co, Bloomington, IN;

C. Indiana Cut Stone, Bedford, IN.

D. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Limestone: Limestone shall be Select Grade Indiana Oolitic limestone as quarried in Lawrence, Monroe or Owens Counties, Indiana. Limestone shall be from a single quarry producing a product that has been tested at the National Bureau of Standards for physical properties and weathering, and shall be free from all defects which would impair its strength, durability or appearance. Stone shall be cut accurately, true and square to shape and dimensions shown. All projecting members shall have a deep drip. Holes and sinkages shall be cut as required for all anchors, cramps, dowels and other accessories.

B. Coursed Ashlar Stone: Coursed ashlar stone shall be coursed ashlar Indiana Limestone as quarried in Lawrence or Monroe Counties. Stone color and finish shall be as specified in the Contract.

1. Bed thickness shall be between three (3) inches and four (4) inches as shown on the Contract Drawings.

2. Course heights shall be 2-1/4-inch, 5-inch, 7-3/4-inch, 10-1/2-inch and 16-inch. Heights to be used, and percentages of each shall be as specified in the Contract.

3. Stone lengths shall be random, varying between 1 foot 6 inches and 4 feet 0 inches, and shall be jointed at the job conforming to the approved jointing pattern.

C. Rough Ashlar Stone: Rough ashlar stone shall be webwall or drywall Indiana Limestone as quarried in Lawrence or Monroe Counties with a rough, broken finish. Stone color shall be as specified in the Contract.

1. Bed thickness shall be as shown on the Contract Drawings.

2. Webwall exposed faces shall vary from 1/2 to 3 square feet.

3. Drywall exposed stone edges shall vary between two (2) inches and six (6) inches in height.

D. Metal Accessories: The Contractor shall provide Type 316 stainless steel for anchors, anchor slots, ties and reinforcement.

E. Rigid Anchors: Rigid ASTM A276, Type 316, stainless steel anchors shall be 1-inch wide by 3/16-inch thick.

F. Weep Holes: Weep holes shall be provided where shown, and shall consist of clear polyethylene, medium density plastic, rectangular tubes, 3/8 inch wide, 1-1/2 inches high, 3-1/2 inches deep.

G. Anchors, Cramps and Dowels for Stone: All anchors, cramps and dowels for stone shall be of Type 316 stainless steel.

H. Mortar Materials: Mortar materials shall be in accordance with Section 04 05 00 - Common Work Results for Masonry.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Field Conditions. Proceed with installation only when existing and forecasted weather conditions permit stone repair work to be performed according to product manufacturers' written instructions and specified requirements. Temperature Limits, General: Repair stone units only when air temperature is between forty (40) and ninety (90) degrees Fahrenheit (four (4) and thirty-two (32) degrees Celsius) and is predicted to remain so for at least seven (7) days after completion of the Work unless otherwise indicated. When air temperature is below forty (40) degrees Fahrenheit (four (4) degrees Celsius), heat mortar ingredients, repair materials, and existing stone to produce temperatures between forty (40) and one hundred and twenty (120) degrees Fahrenheit. When mean daily air temperature is below forty (40) degrees Fahrenheit, provide enclosure and heat to maintain temperatures above thirty-two (32) degrees Fahrenheit within the enclosure for seven (7) days after repair. Hot-Weather Requirements: Protect stone repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of ninety (90) degrees Fahrenheit and above unless otherwise indicated. For manufactured repair materials, perform Work within the environmental limits set by each manufacturer.

B. At locations indicated, remove stone that has deteriorated or is damaged beyond repair. Carefully remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units. Support and protect remaining stonework that surrounds removal area. Remove defective portion of existing stone unit (backing stone). Carefully remove defective

portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman). Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain. If backing stone becomes further damaged, remove damaged area and enlarge partial replacement as required. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush. Cut partial replacement so that, when it is set in final position, natural bedding planes will match the orientation of bedding planes of the backing stone unless otherwise indicated. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- diameter, threaded stainless-steel pins set into 1/4-inch- diameter holes drilled into backing stone and into, but not through, the partial replacement. Center and space pins three (3) to five (5) inches apart and at least two (2) inches from any edge. Insert pins at least two (2) inches into backing stone and two (2) inches into partial replacement, but no closer than 3/4 inch from exposed face of partial replacement.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Engineer of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Replace removed damaged stone with other removed stone in good condition, where possible, or with new stone matching existing stone, including direction of rift or natural bedding planes. Do not use broken units unless they can be cut to usable size.

F. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone. Maintain joint width for replacement stone to match existing joints.

G. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type matching existing configuration.

H. Limestone Setting: Limestone shall be set in nonstaining mortar, true to line and level, with each joint entirely filled with mortar unless otherwise indicated. Plastic buttons shall be used where necessary to prevent crushing of mortar under heavy blocks. Heavy stone or projecting courses shall not be set until the mortar in courses underneath have hardened. All projecting stone shall be securely braced until the wall above it is built and adequately cured.

I. Limestone Joints: All joints shall match existing joint thickness, unless otherwise shown on Contract Drawings. All face joints in stone masonry shall be raked out to a depth of 3/4 inch, brushed clean and caulked with sealant as specified in Section 07 90 00 – Joint Protection, unless otherwise indicated. Relief joints shall be provided in all stonework at intervals matching existing, or not to exceed fifty (50) feet on centers. Copings and all projecting stone shall be set with wash surfaces, and with the vertical and top joints free of mortar. Face or profile of these joints shall be caulked over a backup material in accordance with Section 07 90 00 – Joint Protection. Prior to caulking, all joints shall be primed with a saturating coat of caulking compound primer as recommended by the caulking compound manufacturer.

J. Coursed Ashlar Stone Setting: Coursed ashlar stone shall be set in nonstaining mortar, true to level, with each joint entirely filled with mortar unless otherwise indicated. Plastic buttons shall be used where necessary to prevent crushing of mortar under heavy blocks. Heavy stone or projecting courses shall not be set until the mortar in courses underneath have hardened. All projecting stone shall be securely braced until the wall above it is built and adequately cured.

K. Coursed Ashlar Stone Joints: All joints shall match existing stone joint thickness, unless otherwise indicated on drawings. Relief joints shall be provided in all stonework at intervals to match existing, or not to exceed fifty (50) feet on centers. All projecting stone shall be set with wash surfaces, and with the vertical and top joints free of mortar. Face or profile of these joints shall be caulked over a backup material in accordance with the Contract. Prior to caulking, all joints shall be primed with a saturating coat of caulking compound primer as recommended by the caulking compound manufacturer.

L. Rough Ashlar Stone Setting: Rough ashlar stone, either webwall or drywall, shall be set in nonstaining mortar with each joint entirely filled with mortar unless otherwise indicated. Soft lead pads or plastic buttons shall be used where necessary to prevent crushing of mortar under heavy stones. Heavy stone or projecting courses shall not be set until the mortar in courses underneath has hardened. All projecting stone shall be securely braced until the wall above it is built and adequately cured.

M. Rough Ashlar Stone Joints: All joints shall match existing joint thickness unless otherwise shown on the Contract Drawings. Relief joints shall be provided in all stonework at intervals matching existing, or not to exceed fifty (50) feet on centers. All projecting stone shall be set with wash surfaces, and with the vertical and top joints free of mortar. Face or profile of these joints shall be caulked over a backup material in accordance with the Contract. Prior to caulking, all joints shall be primed with a saturating coat of caulking compound primer as recommended by the caulking compound manufacturer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Stone masonry unit components which are dislodged, damaged, expanded, broken, penetrated or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Contract and properly protected as specified.

B. Protection

1. All components of the Work shall be protected from detrimental weather and damage until construction operations are completed and acceptable to Engineer. Protective boards shall be provided at exposed external corners susceptible to damage by construction activities, without damaging completed work.

2. Work which cannot for reasons acceptable to Engineer be covered with complete construction system before onset of weather detrimental to the Work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.

3. Stone masonry units shall be protected from all damage and abuse from all other Contractors and installers involved in the Work until Final Acceptance by DEP.

C. Cleanup

1. After mortar has set, new stone masonry unit work shall be cleaned as follows:

a. All excess mortar and mortar smears shall be removed. All defective mortar shall be removed and replaced, matching adjacent work. Nonmetallic tools shall be used in all cleaning operations.

b. Stone masonry units shall be washed with clean water and soap powder using stiff bristle fiber brushes.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. This Section furnishes requirements for all iron or steel materials which are to be galvanized as shown on the Contract Drawings.

B. All galvanizing shall be done by the hot-dip process.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Implementation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Acronyms

1. American Galvanizers Association (AGA)

2. Canadian Standards Association (CSA)

B. Reference Standards:

1.	ASTM A53	-	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
2.	ASTM A90	-	Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
3.	ASTM A111	-	Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Wire
4.	ASTM A116	-	Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
5.	ASTM A121	-	Zinc-Coated (Galvanized) Steel Barbed Wire
6.	ASTM A123	-	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
7.	ASTM A143	-	Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
8.	ASTM A153	-	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
9.	ASTM A239	-	Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
10.	ASTM A384	-	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
11.	ASTM A385	-	Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
12.	ASTM A392	-	Zinc-Coated Steel Chain-Link Fence Fabric
13.	ASTM A475	-	Zinc-Coated Steel Wire Strand
14.	ASTM A653	-	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
15.	ASTM A780	-	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

16.	ASTM A924	-	General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
17.	ASTM B6	-	Specification for Zinc
18.	ASTM E536	-	Test Methods for Chemical Analysis of Zinc and Zinc Alloys
19.	ANSI C80.1	-	Rigid Steel Conduit, Zinc Coated
20.	CAN/CSA G164-M92	-	Hot Dip Galvanizing of Irregularly Shaped Articles.

1.05 DESCRIPTION

A. Tests

1. General: Samples of galvanized articles shall be taken as specified in the appropriate ASTMs listed in Table 1. Galvanized articles shall be tested to determine the following qualities of the coating:

   a. Thickness of coating

   b. Adherence

   c. Uniformity.

2. Thickness of the zinc coating may be tested either by the weighing or stripping methods in conformity with the requirements set forth in Table 1.

3. Adherence of zinc coating shall be tested by the method indicated in the appropriate ASTMs listed in Table 1.

4. Uniformity:

   a. Galvanized articles will be subjected to visual examination to determine uniformity of work.

   b. In the event the Engineer determines that such examination is not conclusive, the article shall be given the Preece test in conformity with ASTM A239.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Galvanizing shall be done in a plant having sufficient facilities to produce the quality of coatings herein specified and ample capacity for the volume of work required.

2. The plant shall follow the procedures in the Quality Assurance Manual of the AGA.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. The submittals shall include, but not be limited to:

1. The producer's or supplier's certification that the galvanized articles were manufactured, sampled, tested and inspected in accordance with the applicable standards specified herein and that the articles meet these requirements.

B. A report of the test results shall be furnished to the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling

B. Galvanized articles shall be shipped and handled in a manner which will avoid damage to the zinc coating.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Zinc used for galvanizing shall conform to ASTM B6, and shall be at least equal to the grade designated as Prime Western.

B. Maximum amount of aluminum added to a galvanizing bath shall not exceed 0.01 percent.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Preparation of Materials

1. Structural steel products shall be safeguarded against embrittlement in accordance with ASTM A143.

2. Casting surfaces to be galvanized shall be sand blasted or ground smooth. When a smooth cast is required, castings shall be tumbled and all high spots

ground flush. Castings shall be normalized to prevent cracking. Malleable iron shall be safeguarded against embrittlement by pre-annealling.

3. Steel work shall be pre-cleaned utilizing a caustic bath, acid pickle and flux or shall be blast cleaned and fluxed to obtain an acceptable surface for quality hot dip galvanizing.

3.02 IMPLEMENTATION

A. Hot-Dip Galvanizing Requirements

1. The Work shall conform to the requirements in Table 1 - Schedule of Hot-Dip Galvanizing Requirements.

2. Quality of Coating:

a. The zinc coating shall meet the standards set forth in Table 1, ASTM A385. The coating shall adhere firmly to the surface of the base metal, be continuous, uniform in thickness, and of the quality of finish specified.

b. When special galvanizing, such as heavier coating, flexibility to permit forming operations and similar work is required, it shall be so specified in the Contract.

c. All rejected materials shall be stripped and re-galvanized before resubmitting for inspection and test.

B. Repair of Galvanized Coating

1. Galvanized coatings that are abraded or damaged shall be repaired in accordance with ASTM A780.

2. The extent of the area to be repaired and the method of repair to be used shall be approved by the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

TABLE 1 - SCHEDULE OF HOT-DIP GALVANIZING REQUIREMENTS							
CLASS OF WORK	ZINC		TEST OF ZINC COATING				COATING THICKNESS
	Slab and Chemical Analysis	Coating	Thickness By Weight	Thickness By Stripping	Adherence	Uniformity	Oz. Per Sq. Ft. Minimum
IRON & STEEL STRUCTURAL Rolled, pressed and forged, shapes, castings, plates, bars and strips Gratings, iron and steel	B6, E536	A123	A123	A90, G164-M92	A123	A123, A239	Table 1, A123
SHEETS Iron and steel	B6, E536	A653	A653, A924	A90, A924	A653	A239	Table 1, A653
HARDWARE • Castings of malleable iron and steel • Rolled, pressed, forged articles • Threaded fasteners • Very small work: rivets, nails, tacks, pins, small bolts and screws, stove bolts • Turnbuckles and similar work • Chain	B6, E536	A153	A153	A90,	A153	A153, A239	Table 1, A153
WIRE • Line wire • Fencing wire • Fencing fabric, chain link • Barbed wire • Strand wire	 B6, E536 B6, E536 B6, E536 B6, E536 B6, E563	 A111 A116 A392 A121 A475	 -- -- -- -- --	 A90 A90 A90 A90 A90	 A111 -- -- -- A475	 A111 -- -- -- A475	 Table 1, A111 Table 3, A116 Tables 1 and 2, A392 Table 3, A121 Table 4, A475

TABLE 1 - SCHEDULE OF HOT-DIP GALVANIZING REQUIREMENTS							
CLASS OF WORK	ZINC		TEST OF ZINC COATING				COATING THICKNESS
	Slab and Chemical Analysis	Coating	Thickness By Weight	Thickness By Stripping	Adherence	Uniformity	Oz. Per Sq. Ft. Minimum
PIPE	B6, E536	A53	--	A90	A53	--	1.8 oz. per sq. ft
ELECTRICAL CONDUIT (Rigid Steel)	Shall comply with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.						

Notes Applicable to Table1:
1. Prefixes A, B and E identify ASTM Specifications; prefix G identifies CSA Standard.
2. Galvanized articles shall not be subject to wiping or scraping processes which may reduce the thickness of zinc coating.
3. Small hardware items shall be centrifuged to remove excess bath metal.

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials and equipment required to perform all structural welding as specified herein, and as indicated on the Contract Drawings. The Work shall include, but not limited to, the following items:

1. Procedure specifications.
2. Procedure qualifications.
3. Welder, welding operator and tacker qualifications.
4. Inspection.
5. Testing and repair of defective welds.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	5
1.07	Submittals	8
1.08	Delivery, Storage, and Handling	8
1.09	Spare Parts, Special Tools, and Supplies	8
1.10	Warranty	8
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Application	9
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 12 00 - Structural Steel Framing

1.04 REFERENCES

A. Definitions

1. Definitions of welding terms shall be in accordance with ANSI/AWS A3.0.

B. Reference Standards:

1. AISC-04 - Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design
2. ANSI/AWS A2.4 - Standard Symbols for Welding, Brazing and Nondestructive Examination
3. ANSI/AWS A3.0 - Standard Welding Terms and Definitions
4. ANSI/AWS D1.1 - Structural Welding Code - Steel
5. ANSI/AWS D1.4 - Structural Welding Code - Reinforcing Steel
6. AWS Z49.1 - Safety in Welding and Cutting and Allied Processes
7. American Institute of Steel Construction (AISC)
8. American Welding Society (AWS)
9. New York City Building Code (NYCBC)

1.05 DESCRIPTION

A. All welding shall be performed in accordance with ANSI/AWS D1.1 and ANSI/AWS D1.4. No welding shall be performed when the base metal temperature is lower than thirty-two (32) degrees Fahrenheit.

B. Welding shall not be started until welding procedures, welders, welding operators and tackers have been qualified and copies of all records and reports submitted and approved by the Engineer.

C. The Contractor shall be responsible for the quality of welding and shall maintain records of the test results obtained from the welding procedure, welder, welding operator and tackers performance qualifications.

D. Each weld shown or indicated on the Contract Drawings shall be made as specified on the approved procedure specifications provided to cover each type of weld. Welding of any special steel shall conform to the written instructions of the steel manufacturer.

E. Test specimens shall be prepared by the Contractor for each type of welded joint as designated in Article 1.08, Welding Procedure Qualifications. Destructive tests of specimens for procedure and welder qualifications shall be conducted in accordance with ANSI/AWS D1.1, Section 4, Qualifications, and the requirements specified herein.

F. Symbols

1. Symbols on the Contract Drawings, shop drawings and erection drawings shall be in accordance with ANSI/AWS A2.4.

G. Safety Precautions

1. Safety precautions during welding shall conform to AWS Z49.1.

H. Welding Requirements

1. Contract Drawings will include the following information:

   a. Size, length, type and location of welds.

   b. Location of welds for which non-destructive testing is required. When location of non-destructive testing is not shown, it will be indicated by the Engineer in the field.

2. Workmanship and techniques for welded construction shall conform to the requirements of ANSI/AWS D1.1 and AISC-04. When ANSI/AWS D1.1 and AISC-04 are in conflict, the requirements of ANSI.AWS D1.1 shall govern.

3. Welding of steel reinforcing bars shall conform to the requirements of ANSI/AWS D1.4 and the Contract Documents. Welds shall develop a minimum of 85,000 psi tensile strength. Bars to be welded shall be cut by means of an oxyacetylene torch or by sawing. Ends shall be free of dirt, oxide scale, oil, grease, or other foreign matter. Sheared ends of bars shall be trimmed back at least 1/2-inch by sawing or flame cutting. Preheat and interpass temperature shall conform to ANSI/AWS D1.4. Bars having a carbon equivalent content in excess of 0.50 percent shall not be welded.

4. Where dissimilar strengths of steel are welded together, the procedure used shall be the same as the one used for the lower strength steel.

5. All groove welds shall be 100 percent complete penetration welds as defined in ANSI/AWS D1.1 or shown in ANSI/AWS D1.4 for reinforcing steel, regardless of whether a backup plate is shown or whether the supplementary backing weld or melt-through symbol is included, in each groove-weld symbol shown unless partial penetration is included in the weld symbol.

6. Gun welded studs shall conform to the requirements of ANSI/AWS D1.1, Section 7.

7. Upon completion of welding, all weld splatter, flux, slag and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

I. Standard of Acceptance

1. Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of ANSI/AWS D1.1, ANSI/AWS D1.4 and the Contract Drawings.
2. The welding shall be subject to inspection and tests in the shop and at the Project Site. Inspection and tests in the shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality.
3. All welding exhibiting any cracks, either in the weld metal or the parent metal, will be rejected.
4. Incomplete fusion or lack of penetration will not be allowed, and the weld will be rejected.
5. Welds, other than stud welds, are acceptable if inspection indicates conformance within the following limitations:
    a. Undercut shall not be more than 1/32-inch deep.
    b. Convexity or reinforcement of a weld face shall not exceed the limits shown in ANSI/AWS D1.1, Section 3 and there shall be no overlap.
    c. Slag inclusions, porosity and other fusion defects less than 1/16-inch in greatest dimension will be allowed if well dispersed and the sum of the greatest dimensions in any linear inch of welded joint does not exceed 3/8-inch.
    d. Slag inclusions, porosity and other fusion defects 1/16-inch or larger in greatest dimension will be allowed providing such defects do not exceed the limits specified in ANSI/AWS D1.1.
6. When materials or workmanship do not conform to the acceptance requirements, the Engineer reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

J. Corrections and Repairs

1. General: In lieu of rejection of an entire piece or member containing welding which is unsatisfactory or which indicates inferior workmanship, the corrective measures listed hereinafter may be permitted by the Engineer. The Engineer's specific approval must be obtained before making each correction. Corrective measures shall be made at the Contractor's expense and to the satisfaction of the Engineer and/or to the satisfaction of an independent testing lab.
2. Defective or unsound welds or base metal shall be corrected either by removing and replacing the entire welds, or as follows:
    a. Excessive convexity and overlap shall be reduced by removal of excess weld metal.

b. Any concavity of weld, crater, undersize welds or undercutting shall be corrected by cleaning and depositing additional weld metal.

c. Excessive weld porosity, slag, inclusions or incomplete fusion shall be repaired by removing defective portions and rewelding.

d. Cracks in weld or base metal shall be repaired by removing crack throughout its length, including sound weld metal two (2) inches beyond each end of the crack and rewelding.

3. The removal of defective weld metal or portions of the base metal shall be done by chipping, grinding, oxygen cutting, oxygen gouging, or air carbon-arc and in such a manner that the remaining weld metal or base metal is not nicked or undercut. Defective portions of the weld shall be removed without removal of the base metal.

4. Additional weld metal shall be deposited using an electrode smaller than that used for making the original weld, and not more than 5/32-inch diameter. The surface shall be cleaned thoroughly before welding.

5. Caulking of welds shall not be permitted.

6. Improperly fitted parts may be cut apart and rewelded. Members distorted by welding shall be straightened by mechanical means or by carefully supervised application of a limited amount of localized heat.

a. The temperature of heated areas shall not exceed 1,200 degrees Fahrenheit (a dull red color). Temperature shall be carefully measured with temperature indicating crayons during the heating operation.

b. Parts to be heated for straightening shall be substantially free of stress and from external forces, except those stresses resulting from mechanical means used in conjunction with the application of heat.

7. No peening shall be done on the root or surface layers of a weld. Peening of intermediate weld layers may be used only if authorized by the Engineer and directed by him. Care shall be exercised to prevent overpeening which may cause overlapping, scaling, cracking, flaking, or excessive cold working of weld and base metal.

1.06 QUALITY ASSURANCE

A. Welding Procedure Qualifications

1. General: Except for prequalified or previously qualified procedures, the Contractor shall qualify the welding procedure specifications for any welding procedure performed in the fabrication of weldments. Qualifications of welding procedures shall conform to ANSI/AWS D1.1 and ANSI/AWS D1.4.

2. Welding procedure specification and the results of the procedure qualification test for each type of welding, which requires procedure

qualifications, shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these Specifications. This information shall be submitted on the forms in Annex E of ANSI/AWS D1.1.

a. Procedures, when qualified, become the welding procedure specifications and are to be followed in making welds on the subject materials and provide a means of assuring reproducible results and quality control.

b. Separate procedure specifications shall be prepared for each type of weld.

c. Welding procedure specifications shall be individually identified and shall be referenced on the Shop Drawings and erection drawings, or shall be suitably keyed to the Contract Drawings.

3. Previous Qualifications: Welding procedures previously qualified by test may be acceptable for this Contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory.

b. The qualified welding procedure conforms to the requirements of this Section and is applicable to welding conditions encountered under this Contract.

c. The welder, welding operator and tacker qualification tests conform to the requirements of this Section and are applicable to welding conditions encountered under this Contract.

4. Prequalified Procedures: Welding procedures which are considered prequalified as specified in ANSI/AWS D1.1 and ANSI/AWS D1.4, will be accepted without further qualification.

a. The Contractor shall submit for approval a listing and an annotated drawing to indicate the joints not prequalified.

b. Procedure qualification shall be required for the joints not prequalified.

5. Retests: If welding procedure fails to meet the requirements of ANSI/AWS D1.1 or ANSI/AWS D1.4, the procedure specification shall be revised and requalified.

a. At the Contractor's option, with the Engineer's approval, welding procedure may be retested in accordance with the standards.

b. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

B. Welder, Welding Operator and Tacker Qualification

1. General Information: Each welder, welding operator and tacker assigned to work on this Contract shall be certified in conformance with ANSI/AWS D1.1, Section 4. Welders shall also be New York City certified, and all welding shall be done in conformity with the NYCBC.

2. Certificates: Before assigning any welder, welding operator or tacker to work under this Contract, the Contractor shall submit to the Engineer the names of the welders, welding operators and tackers to be employed and certification that each individual is qualified as specified.

   a. The certification shall state the type of welding and positions for which the welder, welding operator or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests.

   b. The certification shall be kept on file at the job Site by the Contractor. The certification shall be kept current for the duration of the Contract.

3. Identification of Welds: The Contractor shall assign each welder, welding operator or tacker an identifying number, letter or symbol which shall be used to identify all welds made by that person. For identification, the welder, welding operator or tacker shall apply the assigned symbol adjacent to the weld by means of a rubber stamp, felt tipped marker with waterproof ink or other methods that do not cause an indentation in the metal. Identification with die stamps or electric etches shall not be allowed.

4. Record of Welds: The Contractor shall maintain a record of all welders, welding operators and tackers employed on the Contract showing the date and results of tests and the identification mark assigned to each person. These records shall be certified by the Contractor and copies of the records shall be furnished to the Engineer.

5. Previous Qualifications: At the discretion of the Engineer, welders, welding operators and tackers qualified by test within the previous 6 months may be accepted for this Contract without requalification if all of the following conditions are met:

   a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the requirements shown on the Contract Drawings.

   b. Testing was performed by an approved testing laboratory.

   c. The previously-qualified welding procedure conforms to the requirements of this Section and is applicable to welding conditions encountered under this Contract.

d. The welder, welding operator and tacker qualification tests conform to the requirements of this Section and are applicable to welding conditions encountered under this Contract.

6. Renewal of Qualifications: Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which the welder or welding operator is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these Specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing Work under this Contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.07 SUBMITTALS

A. The Contractor shall prepare and submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to, the following:

1. Erection drawings, and catalog data on welding equipment and materials.

2. Welding procedure specifications.

3. Welding procedure qualifications and test records.

4. Welder, welding operator and tacker qualifications and test records.

5. Records of tests and inspections of installed welds.

6. Testing or inspection agency selection.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. All welding equipment, electrodes, welding wire and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures.

B. All welding equipment and materials shall comply with the applicable requirements of ANSI/AWS D1.1 and ANSI/AWS D1.4.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 APPLICATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Supervision

1. All shop and field welding shall be under the immediate supervision of a representative of a standard testing agency or an approved inspection agency reporting directly to, and under the control of, the Department of Environmental Protection.

2. Procedures and techniques for inspection shall be in accordance with the applicable requirements of ANSI/AWS D1.1. The Contractor shall submit the name of such agency to the Commissioner for approval before starting Work.

3. The costs of all welding inspections and tests shall be borne by the Contractor.

B. Inspection and Tests

1. The Engineer will make periodic checks of each welder to determine that welds are being made as specified in the approved procedure specifications. Welding speed may be estimated.
2. All welds will receive 100 percent visual inspection to determine weld size and profile, surface cracks, overlap, and undercut.
3. Welds shall receive non-destructive testing as required in Section 05 12 00 - Structural Steel Framing.
4. The Engineer reserves the right to perform any additional test on any weld, including liquid penetrant, magnetic particle, radiographic, and ultrasonic. The costs of such testing will be borne by the Contractor if unsatisfactory welds are discovered, or by DEP if the welds are satisfactory.

C. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 05 23.02 - MISCELLANEOUS METAL FASTENINGS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all materials, labor, and equipment required to provide all metal fastening in accordance with the Contract Drawings and as specified herein.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	11
2.04	Source Quality Control / Shop Tests	11
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

1. Section 05 05 13.01 - Galvanizing
2. Section 05 05 23.01 - Welding
3. Section 05 12 00 - Structural Steel Framing

1.04 REFERENCES

A. ASTM International (ASTM)

1.	ASTM A 36	-	Carbon Structural Steel.
2.	ASTM A 307	-	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
3.	ASTM A 489	-	Carbon Steel Lifting Eyes.
4.	ASTM A 563	-	Carbon and Alloy Steel Nuts.
5.	ASTM B 348	-	Titanium and Titanium Alloy Bars and Billets.
6.	ASTM D 1785	-	Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
7.	ASTM E 488	-	Standard Testing Method for Strength of Anchors in Concrete Elements
8.	ASTM E 1109	-	Test Method for Strength of Power-Actuated Fasteners Installed in Structural Members
9.	ASTM E 1512	-	Test Method for Testing Bond Performance of Bonded Anchors
10.	ASTM F 436	-	Specification for Hardened Steel Washers Inch and Metric Dimensions
11.	ASTM F 467	-	Nonferrous Nuts for General Use.
12.	ASTM F 593	-	Stainless Steel Bolts; Hex Cap Screws, and Studs.
13.	ASTM F 594	-	Stainless Steel Nuts.
14.	ASTM F 1554	-	Specification for Anchor Bolts, Steel, 36, 55 and 105 ksi Inch and Metric Dimensions
15.	ASTM F 3125	-	Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated 120 ksi and 150 ksi, Minimum Tensile Strength Inch and Metric Dimensions

B. American Concrete Institute (ACI)

1.	ACI 355.2	-	Qualification of Post-Installed Mechanical Anchors in Concrete
2.	ACI 355.4	-	Qualification of Post-Installed Adhesive Anchors in Concrete

C. International Code Council – Evaluation Service (ICC-ES)

1.	ICC-ES AC01	-	Acceptance Criteria for Expansion Anchors in Masonry Elements

2. ICC-ES AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements
3. ICC-ES AC60 - Acceptance Criteria for Anchors in Unreinforced Masonry Elements
4. ICC-ES AC70 - Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements
5. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements
6. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements
7. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

D. American Welding Society (AWS)

1. AWS D1.1 - Structural Welding Code - Steel
2. AWS D1.2 - Structural Welding Code - Aluminum
3. AWS D 1.6 - Structural Welding Code – Stainless Steel

E. American Society of Mechanical Engineers (ASME)

1. ASME B 18.2.1 - Square, Hex Bolts, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lag Screws (Inch Series)
2. ASME B 18.2.2 - Square and Hex Nuts (Inch Series)
3. ASME B 18. 22.1 - Plain Washers

F. New York City Building Code (NYCBC)

G. NYC Buildings Bulletin 2009-019

H. American Institute of Steel Construction (AISC)

1. Steel Construction Manual
2. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges
3. AISC 360 - Specification for Structural Steel Buildings
4. RSCS Specification for Structural Joints Using High-Strength Bolts

I. Aluminum Association

1. Specifications for Aluminum Structures

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project. Fasteners to be tested shall be randomly selected by the Engineer in the field.

B. All welding shall be performed by welders certified in accordance with AWS. Certifications of field welders shall be submitted prior to performing any field welds as per Section 05 05 23.01 – Welding. Welding shall comply with, but not limited to the following:

1. AWS D1.1 for Steel
2. AWS D1.2 for Aluminum
3. AWS D1.6 for Stainless Steel.
4. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer, at no additional cost to DEP.

C. Fasteners and concrete anchors will be inspected in accordance with the Inspection Article in Part 3.

D. Manufacturer’s load tables and certified performance tests for titanium bolts shall be provided.

E. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved Shop Drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples if deemed necessary , inspecting welds, verifying dimensions, and finishing inspections.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for approval by the Engineer. Submittals shall include, but not be limited, to the following:

1. Shop Drawings providing the manufacturer, fastener type, certification of the fastener's material and capacity and product data such as:
    a. Product information
    b. Technical information
    c. Manufacturer’s Installation Instructions (MPII)
    d. ICC-ES Evaluation Report.
2. Copy of valid AWS certification for each person who is to perform field welding.
3. Certified weld inspection reports, when required.
4. Adhesive Anchors

a. For all adhesive anchors, submit anchor sizes and location plan

b. Testing methods, procedures and equipment.

c. In the event that any adhesive anchors fail field testing, submit a detailed procedure for the removal and replacement of those anchors.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials stored outdoors shall be supported above ground surfaces and protected with approved effective and durable covers.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Expansion anchors shall be:

1. Power-Stud+SD1 as manufactured by DeWalt, Brewster, NY;
2. Kwik Bolt 3 (KB3) expansion anchor as manufactured by Hilti, Plano, TX;
3. Strong-Bolt 2 Wedge Anchor as manufactured by Simpson Strong-Tie, Pleasanton, CA;
4. Or approved equal.

B. Screw anchors shall be:

1. Type 316 stainless steel KH-EZ screw anchor as manufactured by Hilti, Plano, TX;
2. Type 316 stainless steel Wedge-Bolt screw anchor as manufactured by DeWalt, Brewster, NY;
3. Type 316 stainless steel Titen-HD screw anchor as manufactured by Simpson Strong-Tie, Pleasanton, CA;
4. Or approved equal.

C. Sleeve or drop-in anchors shall be as manufactured by:

1. Hilti Inc., Plano, TX;
2. DeWalt, Brewster, NY;
3. Simpson Strong-Tie, Pleasanton, CA;

4. Or approved equal.

D. Adhesive Anchors

1. Epoxy adhesive anchor system shall be:
   a. Pure 110+ as manufactured by DeWalt, Brewster, NY;
   b. HIT-RE 500-V3 as manufactured by Hilti, Plano, TX;
   c. Or approved equal.
2. Vinylester adhesive anchor system shall be:
   a. AC200+ as manufactured by DeWalt, Brewster, NY;
   b. HIT HY-200 as manufactured by Hilti, Plano, TX;
   c. A7+ as manufactured by ITW Ramset/Redhead, Glendale Height, IL;
   d. AT-XP as manufactured by Simpson Strong-Tie, Pleasnaton, CA;
   e. Or approved equal.

E. The wedge inserts shall be as manufactured by:
   a. Hohmann & Barnard, Inc., Hauppauge, NY;
   b. Or approved equal.

F. Anchor channel shall be as manufactured by:
   a. Halfen Anchoring Systems, Tampa, FL;
   b. Or approved equal.

G. Masonry Anchors

1. The adhesive system shall be as manufactured by:
   a. Hit HY-70 by Hilti Inc., Plano, TX;
   b. AC100+ Gold by DeWalt, Brewster, NY;
   c. AT (acrylic) or SET (epoxy) by Simpson Strong-Tie, Pleasanton, CA;
   d. Or approved equal.

H. Expansion Bolts in Structural Steel Connections shall be:

1. Type HB Hollo-Bolt as manufactured by Lindapter, Syracuse, NY;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Anchor Bolts

1. Anchor bolts for miscellaneous framing and architectural elements attachments shall conform to ASTM A36 or ASTM A307 Grade A except

where stainless steel or other approved anchor bolts are shown on the Contract Drawings. Anchor bolts shall be of the size and configuration shown on the Contract Drawings and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.

2. Anchor bolts for equipment attachment shall be of stainless steel Type 316 with nitronic 60 stainless steel nuts and locknuts.

3. All underwater anchor bolts shall be Type 316 stainless steel with nitronic 60 stainless steel nuts.

4. Where anchor bolts are used to anchor galvanized steel or are otherwise specified to be galvanized, they shall be hot-dip galvanized in accordance with ASTM A307 and Section 05 05 13.01 - Galvanizing.

5. Pipe sleeves around anchor bolts shall be of the size and configuration shown on the Contract Drawings.

6. Material for anchor bolts submerged in salt water or corrosive liquids for which stainless steel Type 316 is not suitable shall be as indicated in the Contract.

B. Bolts

1. Bolts, nuts and washers for miscellaneous framing and for attachment of architectural elements shall conform to Section 05 12 00 - Structural Steel Framing.

2. Where bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with Section 05 05 13.01 - Galvanizing.

C. Stainless Steel Bolts

1. Stainless steel bolts shall conform to ASTM F593. All underwater fasteners shall be Type 316 stainless steel. Unless otherwise specified, fasteners for aluminum members shall be Type 304 stainless steel. Fasteners for stainless steel members shall be of matching grade.

2. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts and shall have a raised letter or symbol indicating the manufacturer.

3. Nuts for stainless steel bolts for elements which are indicated on the Contract Drawings to be removable shall be made of nitronic 60 alloy.

4. Material for bolts submerged in salt water or corrosive liquids for which stainless steel Type 316 is not suitable shall be as indicated in the Contract.

D. Post-Installed Anchors

1. Concrete anchors shall be one of the types listed below as indicated on the Contract Drawings. Unless otherwise noted, all concrete anchors which are submerged, or which are subject to vibration from equipment such as pumps and generators, shall be injected, adhesive anchors. The determination of anchors equivalent to those listed below shall be based on test data performed by a commercial testing laboratory.

    a. Mechanical Anchors

        1) Expansion anchors shall be wedge, sleeve, or drop-in mechanical anchors.

        2) Screw anchors shall be one-piece threaded anchor with a finished hexagonal head.

    b. Adhesive anchors shall be two part injection type.

    c. Where anchor type is not indicated on the Contract Drawings, the wedge expansion anchor shall be used.

2. Expansion anchors shall be fully threaded, medium duty, Type 316 stainless steel anchors. Shall be sized and embedded to depths as shown on the Contract Drawings. If embedment depth is not given, the standard embedment depth as recommended by the manufacturer shall be used.

    a. Manufacturer for Expansion anchor shall be as specified in this Section.

3. Screw anchors shall be a one piece, heavy duty anchor with a finished hexagonal head. Screw anchors shall be sized and embedded to depths as shown on the Contract Drawings. If embedment depth is not given, the standard embedment depth as recommended by the manufacturer shall be used.

    a. Manufacturer for screw anchor shall be as specified in this Section.

4. Adhesive anchors shall consist of Grade 60 reinforcing steel ASTM A 615, or Type 316 stainless steel ASTM F593 or Grade B7 high strength carbon ASTM A193 threaded rods or bolts anchored with a two-part injection type adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's instructions. The anchor diameter, type, and embedment depth shall be as shown on the Contract Drawings.

    a. The embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable tensile capacity of the rod/bolt (see Table 1) unless noted otherwise on the Contract Drawings.

    b. Manufacturer for Epoxy adhesive and Vinylester adhesive anchor systems and shall be as specified in this Section.

c. Adhesive anchoring system shall have an ICC-ES Evaluation Service Report issued in accordance with AC308.

d. Adhesive for the anchors must qualify under ACI 355.4.

Table 1
Allowable Tensile Capacity (Kips) for Standard Manufacturer Embedment

Size	Concrete Anchors Wedge Type	CONCRETE ANCHORS WITH INJECTION ADHESIVE SYSTEM
3/8"	1.3	2.1
1/2"	2.4	3.8
5/8"	3.3	5.9
3/4"	4.8	8.4
7/8"	5.6	11.0
1"	7.1	15.0

5. Concrete anchors shall be of Stainless Steel Type 316 unless noted otherwise. Concrete anchors for stainless steel attachments shall be of matching grade.

6. All underwater concrete anchors shall be Type 316 stainless steel and shall have nitronic 60 stainless steel nuts.

7. Material for concrete anchors submerged in salt water or other corrosive liquids for which stainless steel Type 316 is not suitable shall be as indicated in the Contract.

E. Concrete Inserts

1. Wedge Type Inserts:

a. The concrete inserts for attachment of shelf angles or brick relieving angles to the reinforced concrete beams or concrete encased steel beams, shall be wedge type inserts. The inserts shall have an askew head bolt to produce an automatic tightening action when a load is placed on the bolt.

b. The wedge inserts shall be of malleable iron, hot dipped galvanized. The askew bolt and the horseshoe shim plates shall be of stainless steel Type 304 or 316. The type of insert and size of bolts shall be as shown on the Contract Drawings.

c. Manufacturer for wedge inserts shall be as specified in this Section.

2. Anchor Channel Inserts: for the top attachment of the masonry wall panels to steel encased or concrete structures, the inserts shall be:

   a. Manufacturer for anchor channel inserts shall be as specified in this Section.

   b. The anchor channel shall be made from channel profiles with "I" anchors shop welded to the back of channels. Anchor channels shall be furnished with the head bolts, channel nuts, etc., for a complete installation. All material shall be stainless steel Type 304.

   c. The type and series of the anchor channel shall be as shown on the Contract Drawings.

   d. Anchor channels can be used for other attachments if detailed on the Contract Drawings.

F. Masonry Anchors

1. Masonry anchors shall be injection adhesive anchors with screen tube for fastening to hollow block, clay tiles and brick with holes (see Table 2).

2. Manufacturer for adhesive system shall be as specified in this Section.

3. Masonry anchors shall be of stainless steel type 304 unless noted otherwise. Masonry anchors for stainless steel attachments shall be of the matching grade.

Table 2
Allowable Tensile Masonry (lbs) in Hollow Concrete Block

Size	MASONRY ANCHORS WITH INJECTION ADHESIVE SYSTEM
1/4"	255
5/16"	370
3/8"	525
1/2"	525

G. Electrodes for Welding

1. Electrodes for welding carbon steel shall comply with Section 05 12 00 - Structural Steel Framing.

2. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

3. Electrodes for welding stainless steel and other metals shall comply with AWS A5.4.

H. Eye Bolts

1. Eyebolts shall be of the size indicated on the Contract Drawings and shall conform to ASTM A489 unless noted otherwise.

2. Carbon steel eyebolts shall be galvanized in accordance with Section 05 05 13.01 - Galvanizing.

I. Titanium Bolts and Anchors

1. Titanium bolts, washers, nuts and anchors shall be provided in, over, and adjacent to containment areas for ferric chloride and sodium hypochlorite, unless indicated otherwise on the Contract Drawings.

2. Bolts and anchors shall be of the size indicated on the Contract Drawings. Bolts, anchors washers and nuts and shall conform to ASTM B 348, Grade 2.

3. Minimum mechanical and physical properties:

a.	Tensile Strength	50,000 psi
b.	Yield Strength	40,000 psi
c.	Elongation in 4" dia.	20%
d.	Modulus of Elasticity	14.9×10^6 psi

J. Expansion Bolts in Structural Steel Connections

1. Expansion bolts for connecting to hollow section steel or where access is restricted (blind-bolts) shall be Type 316 stainless steel with a hex head such as specified in this Section.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall field verify all dimensions and condition of the materials to be connected, review the Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 INSTALLATION

A. Anchor Bolts and Concrete Anchors:

1. Anchor bolts shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template.

2. The installation of concrete anchors shall be done in strict conformance with the manufacturer's field demonstration and recommendations.

3. The holes drilled for adhesive anchors shall be cleaned by use of a fiber bristle brush and dry compressed air. The anchors shall be supported in the correct position until the adhesive sets and gains enough strength to prevent any dislocation. Adhesive anchors shall not be tightened or loaded until the adhesive has fully cured as recommended by the manufacturer.

4. No concrete anchor shall be installed before base concrete has attained specified twenty-eight (28)-day strength.

5. Concrete anchors shall not be used in place of anchor bolts without Engineer's approval.

B. Bolts:

1. All steel bolts shall be installed in conformance with Section 05 12 00 - Structural Steel Framing.

2. Unless otherwise specified, where aluminum and steel members are connected together they shall be fastened with Type 304 stainless steel bolts and isolated with micarta, nylon, rubber, or approved equal.

C. Concrete Inserts: Provide concrete inserts where shown on the Contract Drawings. Inserts shall be firmly held in position in the forms and sealed from intrusion of concrete mortar during concrete placement.

D. Titanium Bolts

1. All bolts shall be installed in conformance with the manufacturer’s recommendations.

2. Titanium anchors shall be installed in accordance with AISC “Code of Standard Practice” by setting in concrete while it is being placed and positioned by means of a rigidly held plate.

E. Adhesive Anchors

1. Concrete is to be a minimum of 21 days old at time of anchor installation

2. Work shall be performed by certified ACI/CRSI Adhesive Anchor Installers under continuous special inspection

3. Shall be installed in accordance with Manufacturer’s Published Installation Instructions (MPII), the applicable ICC-ES ESR and in accordance with NYC Buildings Bulletin 2009-019

4. Adhesive anchoring installation shall be subject to special inspection requirements of NYCBC section BC 1704.32.

5. Adhesive anchor shall be identified by labels on the packaging including manufacturer’s name, product designation and the requirements specified in ICC-ES AC308, Annex A.

F. Welding

1. Welding shall comply with the requirements of Sections 05 12 00 - Structural Steel Framing and 05 05 23.01 - Welding.

3.03 FIELD TESTING / QUALITY CONTROL

A. Inspection

1. Inspection for high strength bolted connections shall conform to the requirements of Section 05 12 00 - Structural Steel Framing.

2. At least twenty-five (25) percent of the concrete anchors required to be installed shall be proof tested to 1.33 times the allowable load specified by the manufacturer of the system.

3. Welding inspection shall be done in accordance with the requirements of Sections 05 12 00 - Structural Steel Framing and 05 05 23.01 - Welding.

4. Inspection of titanium bolted connections shall conform to the requirements of AISC “Code of Standard Practice.”

5. Adhesive Anchors: Adhesive anchoring installation shall be subject to special inspection requirements of NYCBC section BC 1704.32.

B. Testing of Adhesive Anchors

1. Field testing:

a. Testing to be performed by a NYC Buildings Department approved special inspection agency to perform field testing of the installed anchors in accordance with NYCBC BC 1704.32 and ICC-ES ESR and the applicable sections of ASTM E488 in the presence of the Engineer.

b. Anchors that are to be tested are as indicated on the Contract Drawings.

2. Pull-out testing:

a. A total of fifteen (15) percent of the adhesive anchors designated for testing are to be tested and no more than one (1) bolt is to be tested per connection.

b. The Engineer will randomly choose the anchors to be tested.

c. Testing of the adhesive anchors shall not begin until all the anchors are installed.

d. If only one anchor fails, all the adhesive anchors will be accepted. If a second anchor fails, an additional five (5) percent of the anchors shall be tested. If more than twenty (20) percent of the total anchors tested fail, all the anchors shall be removed and replaced.

3. Removal and replacement of failed test anchors:

a. Remove all anchors that fail the field test without damage to the surrounding concrete.

b. Redrill holes to remove adhesive bonding material residue and clean in accordance with MPII.

c. Reinstall new anchors that are the same size as the removed anchors and install the new anchors in the same exact location as the removed anchor. Do not reuse the failed anchors, they shall be discarded.

d. Assign reinstalled anchors into batches only containing reinstalled anchors of the same diameter, embedment length and adhesive bonding material system, and field test in accordance with the above sections.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 06 00.01 - SCHEDULES FOR STAINLESS STEEL WORK
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install, and erect the stainless steel work as specified herein and shown on the Contract Drawings.

B. Stainless steel work shall be furnished complete with all accessories, mountings, and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Implementation	10
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.01 - Welding.

1.04 REFERENCES

A. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

B. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

C. ASTM A262 - Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.

D. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

E. ASTM A314 - Stainless and Heat-Resisting Steel Billets and Bars for Forging

F. ASTM A380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.

G. ASTM A473 - Stainless and Heat-Resisting Steel Forgings.

H. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.

I. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.

J. ASTM F594 - Stainless Steel Nuts.

K. ASME B1.1 - Unified Inch Screw Thread (UN and UNR Thread Form).

1.05 DESCRIPTION

A. Tests

1. All stainless steel materials, including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of Work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

2. Sample selection for the susceptibility to intergranular attack tests shall be as follows:

a. One (1) sample per each heat treatment lot for plates and forgings;

b. One (1) sample per each Welding Procedure Qualification regardless of the joint design;

c. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance;

d. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by DEP representatives. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements specified herein or of the Contract Drawings.

C. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 SUBMITTALS

A. The Contractor shall prepare and submit Shop Drawings for all stainless steel fabrication for approval by the Engineer. Submittals shall include, but not be limited to, the following:

1. Certified test reports for susceptibility to intergranular attack.

2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.

3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Article “Cleaning and Handling” in this Section.

B. Samples of finish, on each type of stainless steel to be furnished, shall be submitted in accordance with the Quality Assurance requirements of the Contract.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material can occur during handling. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface. Corrosion in such areas can be accelerated by the galvanic corrosion effect due to the unfavorable relative area ratios which would exist.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Materials and Finishes

1. Type and finish of stainless steel to be utilized for fabrication shall be the type and finish indicated on the Contract Drawings or as specified herein for the intended service and conforming to the applicable ASTM standard.

2. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.

3. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.

4. There are three standard finished for strip, which are broadly described by the finishing operations employed:

   a. No. 1 Strip Finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.

   b. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.

   c. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1
Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length: Mill finishes Nos. 1, 2D and 2B Polished finishes Nos. 3, 4, 6, 7 & 8	 under 3/16" under 3/16"	 24" and over all widths	 -- --
Strip	Cold finished, coils or cut lengths Polished finishes Nos. 3, 4, 6,7 & 8	under 3/16" under 3/16"	under 24" all widths	-- --
Plate	Flat rolled or forged	3/16" and over	over 10"	--
Bar	Hot finished rounds, squares, octagons and hexagons Hot finished flats Cold finished rounds, squares, octagons and hexagons Cold finished flats	-- 1/8" to 8" incl. -- 1/8" to 4-1/2"	-- 1/4" to 10" incl. -- 3/8" to 4-1/2"	1/4" and over -- over 1/8" --
Wire	Cold finishes only: (in coil) Round, square, octagon, hexagon and flat wire	 under 3/16"	 under 3/8"	 --
Pipe and Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered “standard” shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2

Standard Mechanical Sheet Finishes

Unpolished or Rolled Finishes: No. 1 A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.	No. 4 A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.
No. 2D A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.	No. 6 A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.
No. 2B A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.	No. 7 A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
Polished Finishes: No. 3 An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication.	No. 8 The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Table 3
Conditions and Finishes for Bar

Conditions	Surface Finishes[1]
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned[2] (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated.	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength[3]	(d) Cold drawn or cold rolled (e) Centerless ground (f) Polished

Table 4
Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition.[4]
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance.[1]
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.
Notes: 1. Surface finishes (b), (e) and (f) are applicable to round bars only.	
2. Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.	
3. Produced in Types 302, 303Se, 304 and 316.	
4. Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.	

B.

C. Fasteners

1. Stainless steel fasteners shall be used for joining stainless steel work.

2. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication

1. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.
2. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.
3. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.
4. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.
5. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements

1. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the Work.
2. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 IMPLEMENTATION

A. Installation

1. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.
2. All inserts, anchor bolts, and all other miscellaneous Work specified herein or shown on the Contract Drawings or required for the proper completion of the Work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.
3. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved Shop Drawings.

B. Welding

1. Welding shall be done in a manner that will prevent buckling and in accordance with Section 05 05 23.01 - Welding, and as modified hereinafter.

2. All welds exposed in the Work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.

3. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.

4. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:

   a. Use lower weld current setting.

   b. Use skip-weld techniques to minimize heat concentration.

   c. Use back-up chill bars or other cooling techniques to dissipate heat.

5. Edges of the stainless steel to be welded shall be cleaned of contaminants.

C. Cleaning and Handling

1. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of Work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.

2. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.

   a. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

   b. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

3. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirts, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.

4. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.

   a. Stainless steel and stainless steel welds shall be cleaned with clean sand, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.

   b. Approved methods of cutting grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

   c. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the Work.

D. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all equipment, materials, and services for the fabrication, delivery, unloading, handling, storing, and erection of all structural steel Work as shown on the Contract Drawings and called for herein.

B. Unless otherwise shown, specified or required, design, workmanship and erection shall conform to or exceed the applicable requirements of the documents listed hereinafter in Article “References” included in this Section to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Implementation	10
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Requirements from the following sections also apply to this Section:

1. Section 05 05 13.01 - Galvanizing
2. Section 05 05 23.01 - Welding
3. Section 09 91 00 - Painting

1.04 REFERENCES

A. Definition:

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards:

1. ASTM:

a. A6 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling

b. A36 - Carbon Structural Steel

c. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

d. A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

e. A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

f. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

g. A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

h. A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

i. A563 - Carbon and Alloy Steel Nuts

j. A572 - High-Strength Low-Alloy Columbium-Vanadium Structural Steel

k. A588 - High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield Point to 4-Inches Thick

l. A992 - Standard Specification for Steel for Structural Shapes for Use in Building Framing

m. F436 - Hardened Steel Washers, Inch and Metric Dimensions

n. F 594 - Stainless Steel Nuts

o. F3125 - High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi & 150 ksi Minimum Tensile Strength, Inch and Metric Dimensions

2. ANSI B18.2.1 - Square and Hex Bolts and Screws-Inch Series.

3. ANSI B18.22.1 - Plain Washers

4. ANSI/ASME B18.2.2 - Square and Hex Nuts (Inch Series)

5. American Welding Society (AWS):

a. A5.1 - Carbon Steel Covered Arc-Welding Electrodes

b. A5.5 - Low-Alloy Steel Covered Arc-Welding Electrodes

c. A5.9 - Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Arc Welding Electrodes and Welding Rods

d. A5.17 - Carbon Steel Electrodes and Fluxes for Submerged-Arc Welding

e. A5.18 - Filler Metals for Gas Shielded Arc Welding, Carbon Steel

f. A5.23 - Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding

g. D1.1 - Structural Welding Code

h. QC1 - Qualification and Certification of Welding Inspectors

6. New York City Building Code (NYCBC)

7. New York City Department of Buildings (NYCDOB)

8. American Institute of Steel Construction (AISC):

a. Steel Construction Manual

b. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges

c. AISC 360 - Specification for Structural Steel Buildings

d. RSCS Specifications for Structural Joints Using High-Strength Bolts

e. Design Guide 24 - Hollow Structural Sections

9. Steel Structures Painting Council (SSPC)

10. ISO 14025 - Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. Definition

1. Structural Steel: The term structural steel shall be as defined in the Codes of Standard Practice for Steel Buildings and Bridges of the AISC. Included as structural steel shall be all stiffeners, plates, sag rods and other miscellaneous metal required for a complete installation.

2. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. SUSTAINABILITY PERFORMANCE REQUIREMENTS

1. Recycled Content of Steel Products: Minimum recycled content as stated below.

2. Hot-rolled steel sections: 85 percent.

3. Steel plates: 85 percent.

4. Hollow structural sections: 50 percent.

1.06 QUALITY ASSURANCE

A. All fabrication and erection shall be performed by AISC Quality Certified Companies.

B. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved shop drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting bolt samples, inspecting welds, verifying dimensions, and finishing inspections.

1. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications.

2. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but it is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

C. All welding shall be performed by certified welders under the immediate supervision of a representative of a standard testing agency or a special inspection agency reporting directly to and under the control of the City and meeting the requirements of Section 05 05 23.01 – Welding.

D. The Contractor shall submit the name of such testing agency to the Commissioner for approval before starting Work.

1. All shop and field welds in structural steel shall be visually inspected by an AWS qualified welding inspector. The Contractor shall furnish a letter of certification for each welded connection stating that these requirements have been met.

2. The costs of all welding supervision and inspections shall be borne by the Contractor. The Contractor shall engage inspectors to inspect welded connections and to perform tests and prepare test reports.

3. Nondestructive testing such as radiographic testing or ultrasonic testing, when required, shall be as specified by the Engineer and performed in accordance with the applicable AWS or ASME code. Frequency of such testing shall also be as specified by the Engineer and indicated on the Contract Drawings.

4. Welds that are required by the Engineer and/or inspectors to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense and to the satisfaction of the Engineer and/or an acceptable independent testing lab.

E. The Contractor shall engage an independent testing and inspection agency to inspect high-strength bolted connections. The agency shall report directly and be under the control of the City. The costs of all high-strength bolt inspections shall be borne by the Contractor.

1. Rejected bolts shall be either replaced or retightened as required. In cases of disputed bolt installation, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory. The certification shall be at the Contractor's expense.

F. The Contractor shall be solely responsible for the correctness of all shop and field fabrication and fit.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Layout drawings indicating all materials, structural shapes, sizes, and dimensions.

2. Beam and column schedules.

3. Detail drawings indicating connection and anchoring details.

4. Anchor bolts and setting plans.

5. Erection drawings

B. No fabrication shall be started until Shop Drawings have been approved in writing by the Engineer.

C. The Contractor shall also submit the following:

1. Certified mill test reports
2. Affidavit of compliance with grade specified
3. Certified weld inspection reports
4. Certification for bolts
5. Paint certification
6. Quality certifications for fabricators and erectors.

D. The Contractor shall furnish samples for testing, if required by the Contract.

E. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor Shop Drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area.

C. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

D. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed by the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Structural Steel

1. The fabricator shall provide an affidavit stating that the structural steel furnished meets the requirements of the grade specified. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, at no additional cost to DEP.
2. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.
3. Structural steel for S, M, and HP shapes and channels shall conform to ASTM A572 Grade 50 unless otherwise indicated.
4. Structural steel for angles and plates shall conform to ASTM A36 unless otherwise indicated.
5. Certified mill test reports or certified reports of tests made by the fabricator or a testing laboratory for structural steel in accordance with ASTM A6 and the governing specification shall constitute evidence of conformity with the ASTM Specification.
6. Steel pipe shall be ASTM A53, Type E or S, Grade B.
7. Structural tubing shall be ASTM A500, Grade B. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.
8. Low alloy, high strength, high corrosion resistant steel shall conform to ASTM A 588.
9. High strength Columbium-Vanadium structural steel shall conform to ASTM A 572, Grade 50.

B. Bolts

1. High strength bolts shall conform to ASTM F3125. Other bolts shall conform to ASTM A307. Unless otherwise indicated, all bolts shall be ASTM F3125.

2. Galvanized high strength bolts shall conform to ASTM F3125, Type 1, nuts shall conform to ASTM A563. Galvanizing shall be by the hot-dip process and in accordance with Section 05 05 13.01 - Galvanizing.

    a. Nuts shall meet the requirements of either ASTM A563 for Grade DH, or ASTM A194 for Grade 2H.

    b. Flat circular washers and square or rectangular beveled washers shall conform to the requirements of ASTM F436.

    c. Bolt dimensions shall conform to the requirements for regular semi-finished hexagon bolts, ANSI B18.2.1., unless otherwise specified.

    d. Nut dimensions shall conform to requirements for heavy hexagon semi-finished nuts ANSI/ASME B18.2.2. Washers shall be flat and smooth and their dimensions shall conform to the requirements for heavy plain washers, ANSI B18.22.1.

3. Bolts used to connect dissimilar metals or located in a corrosive atmosphere, as indicated on the Contract Drawings or specified herein, shall be Type 316 stainless steel conforming to ASTM A193 and A194.

4. Bolts not manufactured in the United States shall be tested and certification provided with respect to specified and required quality and strength standards. Certification of origin shall be provided for all United States fasteners. Bolts to be tested will be randomly selected in the field by the Engineer.

C. Anchor Bolts

1. Anchor bolts for structural steel shall be of the size and configuration shown on the Contract Drawings and shall conform to ASTM A307 unless shown or noted otherwise on the Contract Drawings.

D. Welding Electrodes

1. Welding electrodes for manual shielded metal arc welding shall conform to ANSI/AWS A5.1. Carbon steel electrodes and granular flux for the submerged-arc welding process shall conform to ANSI/AWS A5.17 and low-alloy steel electrodes and fluxes for submerged arc-welding shall conform to ANSI/AWS A5.23 as required for the conditions of actual use.

2. Welding electrodes for ASTM A36 steel shall comply with ANSI/AWS A5.1 (minimum tensile strength of 72,000 psi) and shall be E70XX.

3. Welding electrodes for ASTM A588, ASTM A572, and ASTM A992 steel shall comply with ANSI/AWS A5.17 (tensile strength range of 70,000 psi to 95,000 psi) or ANSI/AWS A5.23 wire and flux, and shall be F7XX-EXXX or F7XX-EXX-XX.

4. Gas-welding electrodes for steel shall comply with ANSI/AWS A5.18 (minimum yield strength of 60,000 psi).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication shall be in accordance with the AISC Code of Standard Practice for Steel Buildings and Bridges.

B. Anchor Bolts:

1. All anchor bolts for structural steel erection and other incidental items of the structural steel required to be built into concrete shall be properly set and securely held in position in the forms before the concrete is placed.

2. Anchor bolts and setting plans for steel columns shall be provided at the site, marked, or tagged for ready identification.

3. Anchor bolts shall be accurately set to template and at elevation to provide suitable projection above concrete and/or grout as specified in AISC Code of Practice. Anchor bolts shall be set perpendicular to the theoretical bearing surface.

4. All holes in structural steel members required for anchors, anchor bolts, bolt holes, connection angles, supports and braces for stair stringers, equipment apparatus, sag rods, or other members noted on the Contract Drawings shall be provided by the fabricator and detailed on the Shop Drawings.

5. Where misalignment between anchor bolts and bolt holes in steel members is encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

C. All materials shall be properly worked and match-marked for field assembly. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

D. Connections:

1. Unless noted otherwise on the Contract Drawings, all beam connections shall be designed for reaction values indicated on the Contract Drawings. Wherever beam reaction values or connection details are not shown, the connection shall be designed to support half the total uniform load capacity tabulated in the AISC tables for allowable loads for laterally supported beams for the given shape, span, and steel specified for the beam in question.

2. Unless noted otherwise on the Contract Drawings, all beam connections designed by the fabricator shall conform to tables for Framed Beam Connections in AISC Manual of Steel Construction.

3. Except where otherwise noted on the Contract Drawings or in this Specification, all shop connections shall be welded.

E. Where shop assembly of field connections is shown, specified or required, the unmatched holes shall be reamed and the pieces matchmarked before disassembly. The interchange of matching parts will not be permitted.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurement

1. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

2. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 IMPLEMENTATION

A. Erection

1. The erection of all structural steel shall conform to the applicable requirements of the Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings of the AISC.

   a. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

   b. High strength steel bolts shall conform to the AISC Specifications for Structural Joints Using High-Strength Bolts.

2. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

3. High Strength Steel Bolts

   a. The furnishing and installation of high-strength bolts, washers and nuts shall be in conformity with:

      1) Relevant sections of the NYCBC.

      2) Latest issue of Rules Relating to High-Strength Bolts by the NYCDOB.

   b. All bolted connections shall use high strength bolts in bearing-type connections according to the AISC Specification for Structural Joints Using High-Strength Bolts.

   c. Where indicated, high strength bolts in slip-critical connections shall be used according to AISC Specification for Structural Joints Using High-Strength Bolts. The Engineer shall approve the

procedure for calibration of wrenches and installation of bolts and, in general, shall satisfy himself that all requirements of the Specifications for Structural Joints Using High-Strength Bolts are met.

4. Cutting and Burning: The use of a gas cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Its use may be permitted on minor members if the member is not under stress, and only after the written approval of the Engineer has been obtained.

   a. No cutting of structural steel members in the field will be allowed except by written approval of the Engineer.

   b. All cutting shall be done with an oxyacetylene torch in conformity with the NYCBC and AWS.

5. Grouting of Base Plates and Bearing Plates: All loose column base plates and billets shall be accurately set to the designated levels on steel wedges or angle screeds in preparation for grouting under this Section. Leveling plates grouted in place shall be installed under all structural steel columns.

   a. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all foreign materials, and concrete and masonry bearing surface shall also be cleaned of all foreign materials and roughened to improve bonding.

   b. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

   c. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

6. Welding:

   a. Welding, where required, shall be performed in accordance with the requirements of:

      1) Section 05 05 23.01 – Welding.

      2) AWS D1.1 Structural Welding Code.

      3) Relevant sections of the NYCBC when applicable.

   b. In assembly and during welding, the component parts of built-up Work shall be held in place by sufficient clamps, temporary bolts, or other adequate means to keep parts in proper position. Where temporary bolts are used, to hold the parts together in steel plates or similar work, the temporary bolts shall be removed and the holes shall be filled with welding material where practical. Otherwise, the

nuts shall be tightened and the bolt threads outside the unit shall be burned and the bolt peened to prevent the nut from loosening.

7. Misfits at Bolted Connections:

a. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

b. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

B. Frame Assembly

1. Structural frames shall be set accurately to the lines and elevations indicated on the Contract Drawings. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

2. Individual members of the structure shall be leveled and plumbed within AISC tolerances. The Contractor shall provide and install all temporary bracing required until structure is complete.

C. Painting

1. General Requirements:

a. Structural steel work shall be painted in accordance with Section 09 91 00 - Painting. All painting performed at the fabricator's shop shall be subject to inspection by the Engineer, and all parts of the work shall be made accessible to the Engineer.

1) All structural steel shall be given one prime coat before shipment to the field.

2) Structural steel encased in concrete shall not be painted.

3) Structural steel encased in masonry or which will be otherwise inaccessible in the finished work, shall receive two shop coats. After erection and before the steel is enclosed, all damaged surfaces shall be prepared and touched-up.

4) No paint shall be permitted on faying surfaces of slip critical joints unless it is qualified by test in accordance with AISC "Test Methods to Determine the Slip Coefficient for

Coatings used in Bolted Joints" as adopted by the Research Council on Structural connections. Manufacturer's certification shall include a certified copy of the test report.

5) Prime coat shall be compatible with fireproofing system.

b. All structural steel work specified to be painted shall be sand blasted or wheel abraded by the fabricator, of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter to satisfy the following specifications of the SSPC:

1) SSPC SP-6, Commercial Blast Cleaning, for all steel except steel subject to immersion.

2) SSPC SP-10, Near-White Blast Cleaning, for steels subject to immersion.

c. Cleaned steels shall be primed within 6 hours after cleaning to prevent formation of new rust.

2. Finished Surfaces: Machine finished surfaces with zero clearance metal to metal contact shall be protected against corrosion by rust-inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3. Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

4. Defective Work: The Contractor shall correct such work as found to be defective under this Article of the Sections.

D. Galvanizing

1. All steel noted to be galvanized on the Contract Drawings or specified herein shall be galvanized in accordance with Section 05 05 13.01 - Galvanizing.

2. All bolts and anchor bolts connecting galvanized steel members shall be galvanized.

3. Shop paint primer shall be omitted from steel to be galvanized.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 40 00 – COLD-FORMED METAL FRAMING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install cold-formed metal framing as indicated on the Contract Drawings and in accordance with the requirements specified herein.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 13.01 - Galvanizing

1.04 REFERENCES

A. ASTM A568 - Steel, Sheet, Carbon and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled, General Requirements for.

B. ASTM A570 - Steel Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

C. ASTM A611 - Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.

D. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. ASTM C645 - Nonstructural Steel Framing Members.

F. ASTM C955 - Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

G. AISI S100 - Specification for the Design of Cold-Formed Steel Structural Members.

H. NYCBC - New York City Building Code

1.05 DESCRIPTION

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated:

1. Design Loads: as required by New York City Building Code and as indicated on the Construction Documents.

2. Deflection Limits: Design framing systems to withstand deflection limits per the requirement of the finish material or as specified on the Construction Documents.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of one hundred and twenty (120) degrees Fahrenheit.

1.06 QUALITY ASSURANCE

A. Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.

C. All metal framing assemblies shall be inspected and approved by the Engineer prior to application of finish materials. Assemblies not approved shall be replaced with new material.

D. All defective, damaged or substandard quality work will be rejected and replaced with new work in accordance with the Contract Documents at no additional expense to the City.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's data sheets and erection instruction for each item specified.

2. Layout and installation drawings for load bearing framing members showing size and gauge designations, number, type, location, and spacing.

3. Drawings indicating supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

B. The Contractor shall submit design calculations for the cold-formed metal framing prepared and sealed by a Professional Engineer licensed in the State of New York and recognized as an expert in the specialty involved. Calculations shall include: design criteria; engineering analysis depicting stress and deflection requirements for each framing application; selection of framing components, accessories and welded connection requirements; and attachments to structure and adjacent framing components.

C. The Contractor shall also submit samples of all framing components and fasteners.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, and grade.

B. Storage

1. Store materials off ground in a dry ventilated space or protect with waterproof tarpaulins that permit the movement of water vapor, so as not to create a humidity chamber.

2. Protect metal framing units from rusting and damage.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. For 16-gauge and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; conforming to ASTM A570, A611 or A653.

B. For 18-gauge and lighter units, fabricate metal framing of commercial quality steel sheet with a minimum yield point of 33,000 psi; conforming to ASTM A570, A611 or A653.

C. Steel runners (track), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories shall be provided in accordance with manufacturer's recommendations for applications indicated on the Contract Drawings, and as needed to provide a complete metal framing system.

D. Studs, tracks, etc., shall conform to ASTM C955.

E. Galvanized finish of metal framing components shall be provided in accordance with Section, Section 05 05 13.01 - Galvanizing and ASTM A653.

F. Where framing units are components of assemblies indicated for a fire-resistance rating, provide units which have been approved by authorities having jurisdiction.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion. Fabricate panel to a maximum allowable tolerance variation plumb, level, and true to line of 1/8 inch in ten (10) feet.

B. Attach similar components by welding. Attach dissimilar components by welding, bolting or screw fasteners, as standard with manufacturer. Wire tying of framing is not permitted. Repair galvanized surfaces damaged by welding with zinc rich paint.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall examine all Contract Drawings covering the Work of this Section, and refer to all other Contract Drawings which may affect this Work or require coordination by this trade.

B. Execution of Work of this trade constitutes acceptance of adjoining Work and other conditions as being satisfactory in every respect. Later claims of defects in such cases will not constitute relief in any way from the requirement of these Specifications.

3.02 INSTALLATION

A. Install metal framing system in accordance with manufacturer's printed instructions and recommendations.

B. Install continuous tracks sized to match studs. Align tracks accurately to layout base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed twenty-four (24) inches. Provide fasteners at corners and end of track.

C. Set studs plumb where stud system abuts columns or walls, anchor ends of stiffeners to supporting structure.

D.

E. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

F. Install horizontal stiffeners in stud system, spaced vertically at not more than four (4)-feet and six (6)-inches on center. Weld at each intersection.

G. Install joists level and plumb, complete with bracing and reinforcing recommended by manufacturer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 05 50 00 - METAL FABRICATIONS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, materials, and equipment required to fabricate and install all metal fabrications not specifically included in other Sections and required for the completion of the Work as shown on the Contract Drawings and as specified herein.

B. Metal fabrications shall be provided complete with all accessories, base attachments, fastenings, and other appurtenances as specified and as may be required for a satisfactory installation.

C. Unless otherwise shown, specified, or required, design, workmanship, and erection shall conform to or exceed the applicable requirements of the documents listed hereinafter in Article 1.04 to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Implementation	10
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A.	Section 05 06 00.01	-	Schedules for Stainless Steel Work
B.	Section 05 05 13.01	-	Galvanizing
C.	Section 05 05 23.01	-	Welding
D.	Section 05 05 23.02	-	Miscellaneous Metal Fastenings
E.	Section 05 12 00	-	Structural Steel Framing
F.	Section 05 52 13.05	-	Welded Pipe Railings (Stainless Steel)
G.	Section 05 53 01.02	-	Stainless Steel Floor Gratings
H.	Section 09 91 00	-	Painting

1.04 REFERENCES

A.	ASTM A36	-	Structural Steel.
B.	ASTM A48	-	Gray Iron Castings.
C.	ASTM A276	-	Stainless and Heat-Resisting Steel Bars and Shapes.
D.	ASTM A480	-	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plates, Sheet and Strips.
E.	ASTM A666	-	Austenitic Stainless Steel, Sheet, Strip Plate and Flat Bar.
F.	ASTM B209	-	Aluminum and Aluminum-Alloy Sheet and Plate.
G.	ASTM B221	-	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
H.	ASTM B308	-	Aluminum-Alloy 6061-T6 Standard Structural Profiles.
I.	ANSI/ASSP Z359.16-2016 – Safety Requirements for Climbing Ladder Fall Arrest Systems		
J.	ANSI/AWS D1.1	-	Structural Welding Code.
K.	ANSI/AWS D1.2	-	Structural Welding Code - Aluminum.
L.	New York City Building Code (NYCBC).		
M.	American Institute of Steel Construction (AISC).		
N.	AISC Manual of Steel Construction.		
O.	AISC Specification for Design and Fabrication of Structural Steel for Buildings Including the Commentary.		
P.	Aluminum Association Specifications for Aluminum Constructions.		
Q.	Aluminum Company of America, "Welding and Brazing Aluminum".		

R. Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the City's representatives. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication Work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications.

C. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Section.

D. Design of Members and Connections:

1. All details shown are typical; similar details shall apply to similar conditions, unless otherwise shown or specified. Dimensions shall be verified at the Site without causing delay in the Work.

2. Each fabricator shall be responsible for the structural design of miscellaneous metal work within the requirements established by these Specifications.

E. Complete design calculation and Shop Drawings shall be prepared, signed and stamped with the seal of a Professional Engineer, licensed to practice in the State of New York with a minimum of 10 years of experience and recognized as an expert in the required work unless the design and details have been shown on the Contract Drawings.

F. "Pencil-line" thin butt joints shall be provided.

G. Shop Assembly: Items in the shop shall be preassembled to the greatest extent possible, so as to minimize field splicing and assembly of units at the Site. Units shall be disassembled only to the extent necessary for shipping and handling limitations. Units shall be clearly marked for reassembly and coordinated installation.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and other materials for the approval by the Engineer. Shop Drawings shall include, but not be limited to, the following:

1. Layout drawings shall indicate all structural shapes, sizes, and dimensions.

2. Certifications, schedules, design calculations, detailed drawings, plans, elevations, and details of sections and connections

3. Detail drawings shall indicate jointing and anchoring details.

4. Anchor bolts and setting plans

5. Erection drawings

B. No fabrication shall be started until Shop Drawings have been approved by the Engineer.

C. The following shall also be submitted:

1. Manufacturer’s specifications, load table, installation instructions, setting drawings and templates for location and installation of miscellaneous metal items, appurtenances and anchorage devices.

2. Certified weld inspection reports.

D. Representative samples of bolts, anchors and inserts shall be submitted as requested by the Engineer. The Engineer's review shall be for type and finish only. Compliance with all other requirements shall be the exclusive responsibility of the Contractor.

E. Record Drawings: During progress of the Work, an up to date set of drawings showing field and Shop Drawing modifications shall be kept. Immediately upon completion of Work, Record Drawings showing the actual in-place installation of all Work constructed and/or installed under this Section shall be submitted to the Engineer. Drawings shall include all necessary plans, sections and details, with all reference dimensions and elevations required for complete Record Drawings of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Metal fabrications shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Metal fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable covers approved by the Engineer.

C. Metal fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged metal fabrications or materials as directed by the Engineer.

D. Materials shall be delivered to the Site at such intervals to insure uninterrupted progress of the Work. Anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry shall be delivered, in ample time not to delay that Work.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Floor access hatch shall be as manufactured by:

1. The Bilco Company, Zanesville, OH;
2. Or approved equal.

B. Fall Prevention System

1. Ladder safety system shall be:
   a. PeakWorks 2000 Series Climb-Rite Fixed Rail Ladder Safety System as manufactured by SureWerx.
   b. Miller Saf-T-Climb System as manufactured by Honeywell.
   c. Or approved equal.
2. Full body Harness shall be:
   a. PeakPro Harness as manufactured by SureWerx;
   b. Miller Saf-T-Climb Harness as manufactured by Honeywell;
   c. Or approved equal.
3. Shuttle/Trolley shall be:
   a. PeakWorks 2000 Climb-Rite Trolley as manufactured by SureWerx.
   b. Miller Saf-T-Grip Shuttle as manufactured by Honeywell.
   c. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Materials

1. Structural steel shapes shall be fabricated in accordance with the details shown on the Contract Drawings and shall conform to the requirements of Section 05 12 00 - Structural Steel Framing and ASTM A36 unless otherwise indicated. All steel shall be galvanized in accordance with the requirements of Section 05 05 13.01 - Galvanizing, and shop painted in accordance with Section 09 91 00 - Painting.

2. Aluminum shapes and plate shall be 6061-T6 aluminum alloy with mill finishes, and shall be fabricated into finished products with welded or bolted connections as detailed on the Contract Drawings. Extruded shapes shall conform to the requirements of ASTM B221 and ASTM B308; plate and sheets shall conform to ASTM B209.

3. Stainless steel shapes and plate shall be Type 316 stainless steel for bolted constructions and 316L for welded construction as detailed on the Contract Drawings and conforming to the applicable requirements of Section 05 06 00.01 - Schedules for Stainless Steel Work. Shapes shall conform to ASTM A276. Stainless steel plates shall conform to ASTM A480 and ASTM A666.

4. Bolting hardware shall be as specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

5. Concrete anchors shall be as specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

B. Access Stairs, Ship Ladders and Platforms

1. Platforms, associated access stairs and ship ladders shall have galvanized steel or aluminum structural members, aluminum stair treads, and aluminum platform gratings as specified herein unless shown otherwise on the Contract Drawings.

2. Structural steel sections shall conform to ASTM A36 and all work shall conform to the AISC Manual of Steel Construction.

3. Platform and stair tread gratings pattern shall be as specified in Section 05 53 01.02 – Stainless Steel Floor Gratings. Stair treads shall be designed to support a uniform live load of 175 pounds per square foot with a maximum deflection of 1/240 of the span. The stair treads shall have an abrasive nosing as shown on the Contract Drawings.

4. Aluminum platform grating shall be designed for the loads as specified herein or as shown on the Contract Drawings.

5. Stainless steel handrails shall be as specified under Section 05 52 13.05 - Welded Pipe Railings (Stainless Steel) and shall be coordinated with stair, ship ladder and platform fabrication. Handrail attachment to stairs, ship ladders and platform shall be in accordance with the details shown on the Contract Drawings.

C. Floor Access Hatches

1. Floor access hatches shall be double leaf, Type JD hatches except for openings less than 4 feet long which shall have single leaf hatches Type J. Manufacturer for floor access hatch shall be as specified in this Section.

2. Hatch size shall be as shown on the Contract Drawings. Hatch leaf shall be of aluminum diamond-pattern plate designed to withstand a live load as

indicated on the Contract Drawings for the adjacent floor or deck area. Channel or tee type frame shall be of aluminum with an anchor flange around the perimeter and with a 1-1/2 inch drainage coupling where required.

3. All hardware shall be of stainless steel and shall include heavy forged hinges, spring operators, an automatic hold-open arm with release handle, and a snap lock with removable handle. The location of hinges, hold-open arm with release handle shall be as shown on the Contract Drawings and/or approved by the Engineer.

4. Access hatches supporting floor loads shall be detailed and fabricated based on calculations indicating that they comply with New York City Building Code for the loading designated on the Contract Drawings for the adjacent floor area. If no loading is designated, a minimum design load of 300 pounds per square foot shall be used or as required for the intended use.

5. If the access doors are located in areas subject to vehicular traffic, they shall be designed for HS-20 loading.

D. Galvanized Accessories

1. Galvanized lintel and shelf angles, angle door guards, floor curb, sill angles and guard posts (bollards), and brackets shall be fabricated from structural steel. Work shall conform to the details on the Contract Drawings and approved shop drawings. Where the material for lintels and shelf angles is not shown on the Contract Drawings, they shall conform to the requirements for “Stainless Steel Lintels and Shelf Angles” as specified herein.

2. Materials and fabrication shall conform to Section 05 12 00 - Structural Steel Framing and ASTM A36. All galvanizing shall be done after fabrication and shall conform to the requirements of Section 05 05 13.01 - Galvanizing.

E. Stainless Steel Lintels and Shelf Angles

1. Lintels and shelf angles shall be bent or rolled angles, fabricated of stainless steel Type 316. All angles shall conform to the sizes, shapes, dimensions and details as noted on the Contract Drawings. The lintels assembled by welding shall be fabricated of stainless steel Type 316L.

2. All mounting and assembly hardware shall be Type 316 stainless steel.

F. Anchor Bolts

1. Anchor bolts shall be as specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

G. Cast Iron Manhole Steps

1. Manhole steps shall be made of gray cast iron conforming to ASTM A48, Class 35B. Manhole steps shall comply with OSHA 1910.24.

2. The steps shall be designed to be cast in place hooking behind the reinforcing steel.

H. Vertical Ladders

1. Aluminum ladders shall be fabricated from aluminum 6061-T6 as detailed on the Contract Drawings.
2. Stainless steel ladders shall be fabricated from Type 316L stainless steel as detailed on the Contract Drawings.
3. Wall mounted ladders shall have welded brackets attached to the wall with concrete or masonry anchors.
4. Ladders shall comply with OSHA 1910.23.
5. A personal fall arrest system or ladder safety system shall be required on all fixed ladders that extend more than twenty-four feet above a lower level as specified in OSHA 1910.28.
6. The third rail required for the fall prevention system shall be of the same material as the ladder.

I. Wall Mounted Rungs

1. Stainless steel rungs shall be fabricated from Type 316L stainless steel as detailed on the Contract Drawings.
2. Rungs will have a knurled tread surface to prevent slips.

J. Slip-Resistant Rung Covers

1. The slip-resistant rung covers shall be safety yellow FRP with embedded coarse grit over a stainless steel base.
2. The shape of the slip-resistant rung cover must match the rung to which it will be applied; round rungs will receive round covers and squared-off rungs squared off covers.
3. Slip-resistant rung covers are to be sized by the manufacturer and will not be cut in the field.
4. On installation, slip-resistant rung covers are to be affixed to the ladder rungs with an appropriate outdoor adhesive, in accordance with manufacturer’s instructions.

K. Fall Prevention System

1. All fixed ladders that extend more than twenty-four feet above a lower level shall be provided with a fall prevention system.
2. Fall prevention systems shall comply with OSHA 1910.28, OSHA 1910.29, and ANSI Z359.16.
3. All necessary components of the fall prevention system shall be furnished, including two trolley/shuttle and two full-body harnesses for each fall

prevention installation, to provide a complete and fully operational fall prevention system. Full-body harnesses shall be size medium where not universally sized.

L. Stair Nosings

1. Provide non-slip nosings on all treads of interior stairs that are not scheduled for resilient flooring or rubber tile finishes.

2. Non-slip nosings shall be as manufactured by one of the following manufacturers:

a. Wooster Products, Inc., Wooster, OH.

b. Safe-T-Metal Co., Syracuse NY.

c. Or approved equal.

3. Nosings shall be four inches wide and six inches less in length than the length of the tread.

4. Nosings shall be installed at the edge of each tread, landing, and platform. Top of surface shall be flush with concrete finish.

5. Each nosing shall utilize a minimum of three anchors into the concrete.

6. Nosings shall be cast aluminum, Alloy 356-T6.

M. Steel Bollards

1. Galvanized steel pipe bollards shall be fabricated to dimensions and details indicated in the Contract Drawings. Bollards shall be fabricated from eight (8)-inch nominal outside diameter pipe, extra strong.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication of steel and stainless steel shall be in accordance with the Specification for the Design Fabrication and Erection of Structural Steel for Building of the AISC. Fabrication of aluminum shall be in accordance with the Aluminum Association Specifications for Aluminum Structures.

B. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.

C. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved Shop Drawings.

D. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.

E. Welding of carbon and low alloy steel shall conform to the applicable requirements of ANSI/AWS D1.1, and Section 05 05 23.01 - Welding. Welding of aluminum shall conform to the applicable recommendations of the Aluminum Company of America publication, "Welding and Brazing Aluminum"; ANSI/AWS D1.2 and

Aluminum Association Specification for Aluminum Constructions. Welding shall be done in a manner that will prevent permanent buckling and all welds exposed in the finished Work shall be ground smooth.

F. All finished and/or machined faces shall be true to line and level. Steel and aluminum shall be standard, and well finished. Sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

G. All Work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all Work so as not to damage the finished surfaces.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements

1. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the Work.

2. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

B. Inspection

1. The Contractor shall examine the alignment of the substrate and conditions under which metal fabrication Work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the metal fabrication and installation Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 IMPLEMENTATION

A. Installation

1. All metal fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.

2. All inserts, anchor bolts and all other miscellaneous metal work specified herein or shown on the Contract Drawings or required for the proper completion of the Work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

3. All miscellaneous metal fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved Shop Drawings.

B. Galvanizing

1. All miscellaneous steel fabrications shall be galvanized after fabrication in accordance with Section 05 05 13.01 - Galvanizing.

2. Galvanized surfaces damaged during installation shall be touched up with a galvanizing repair paint applied in accordance with the manufacturer's instructions.

C. Painting

1. All miscellaneous metal fabrications other than aluminum or stainless steel, shall be painted in accordance with the requirements of Section 09 91 00 - Painting.

2. All galvanized metal fabrications, that have the surfaces exposed in the finish work, shall be painted in accordance with Section 09 91 00 - Painting.

3. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of an epoxy paint with a total thickness of 16 mils or other approved isolating material.

4. Surface preparation shall be done in accordance with Section 09 91 00 - Painting.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 05 51 00 – METAL STAIRS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, fabricate, assemble, and install all metal stairs, steel pans, or steel stairs for the Work as required in the Contract Drawings and Specifications.

B. Metal stairs shall be furnished complete with all accessories, base attachments, fastenings, and other appurtenances as specified or as may be required for a satisfactory installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Requirements from the following sections also apply to this Section.

1. Section 05 05 13.01 - Galvanizing.

2.	Section 05 05 23.01	-	Welding.
3.	Section 05 05 23.02	-	Miscellaneous Metal Fastenings.
4.	Section 05 12 00	-	Structural Steel Framing.
5.	Section 05 52 13.05	-	Welded Pipe Railings (Stainless Steel).
6.	Section 09 91 00	-	Painting.

1.04 REFERENCES

A. No definition of additional term is required for this Section.

B. No reference standards are required for this Section.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the City or its representatives.

B. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be scheduled.

C. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications.

D. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but it is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

E. Design of Members and Connections:

1. All details shown are typical; similar details shall apply to similar conditions, unless otherwise shown or specified. Dimensions shall be verified at the Site without causing delay in the Work.

2. Each fabricator shall be responsible for the structural design of miscellaneous metal work within the requirements established by these Specifications.

F. Complete design calculation and Shop Drawings shall be prepared, signed, and stamped with the seal of a Licensed Professional Engineer, licensed and registered to practice in the State of New York and recognized as an expert in the required Work unless the design and details have been shown on the Contract Drawings.

G. Shop Assembly: Items in the shop shall be preassembled to the greatest extent possible, so as to minimize field splicing and assembly of units at the Site. Units shall be disassembled only to the extent necessary for shipping and handling limitations. Units shall be clearly marked for reassembly and coordinated installation.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications of the metal stairs for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Complete layout and installation drawings and schedules with clearly indicated dimensions for metal stairs.

2. All grating shop drawings shall clearly indicate the orientation of the bearing bars.

B. Samples shall include:

1. Aluminum stair nosings.

2. Metal stair treads.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be boxed or crated and suitably protected against damage from handling and the elements prior to shipment from the place of fabrication.

B. All materials shall be protected on the Site and/or incorporated in the Work free from damage or marring of any kind.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. General:

1. All materials shall be of the very best quality and entirely suited for the service to which they will be subjected.

2. Welding shall conform to the applicable requirements of Section 05 05 23.01 - Welding.

3. Fastening: Bolts, nuts, and inserts shall be of the best quality mild steel conforming to the applicable requirements of Section 05 05 23.02 - Miscellaneous Metal Fastenings. Bolts shall have hexagonal nuts. All threads shall be clean cut of the American Standard size.

a. Expansion shield anchors shall be used only where shown on the Contract Drawings. Power driven "pin" or "stud" type fasteners

shall not be permitted. Anchors shall be sized and installed to the proper depths as required by the loads in accordance with manufacturer's recommendations.

b. Carbon steel fasteners shall be galvanized in accordance with Section 05 05 13.01 - Galvanizing and painted in accordance with Section 09 91 00 - Painting.

4. Structural steel shapes shall be installed as shown on the Contract Drawings and shall conform to the requirements of Sections 05 12 00 - Structural Steel Framing and 05 52 13.05 - Welded Pipe Railings (Stainless Steel), for Welded Pipe Railings.

B. Steel Stairs

1. The metal stairs and platforms shall be of galvanized steel construction with aluminum treads, landings, and railings constructed to conform to the sizes and arrangements as shown on the Contract Drawings, required by the Contract and specified herein.

2. Entire stair assembly shall be constructed to support a minimum live load of one hundred (100) pounds per square foot. Steel framing, hangers, columns, struts, clips, brackets, bearing plates, and other components shall be provided as required for the support of stairs and platforms.

3. Steel brackets and bearing surfaces shall be provided as detailed on the Contract Drawings and as required to anchor and contain the stairs on the supporting structure.

4. Where masonry walls occur, supporting struts shall be provided and shall be designed for the erection and support of stair components before installation of masonry.

5. Steel framing stringers shall be fabricated of structural steel shapes as shown on the Contract Drawings. Closure pieces shall be provided for exposed ends of stringers. All structural steel elements shall be galvanized.

6. Platforms shall be constructed of structural steel channel headers and miscellaneous steel framing members as shown on the Contract Drawings. Headers shall be bolted to stringers and framing members shall be bolted to stringers and headers. Aluminum surfaces in contact with steel shall be properly isolated.

7. Aluminum stair treads shall have a 1-1/4 inch-wide abrasive nosing. Stair construction shall be coordinated with the railing fabricator for location of post supports.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Aluminum and steel shall be standard, well finished, structural, or bar aluminum or bar steel. Sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

B. Welding shall be used for joining pieces together unless otherwise shown or specified. Units shall be fabricated so that bolts and other fastenings do not appear on finished surfaces. All joints shall be true and tight, and connections between parts light-proof tight. Continuous welds shall be provided and ground smooth where exposed.

C. Welding shall be done in a manner that will prevent permanent buckling and all welds exposed in the finished and/or machined faces shall be true to line and level.

D. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water. Work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws, and other fastenings, ensure rigidity, and provide close fitting of sections.

E. All Work shall be fitted together at the shop as far as possible and delivered complete and ready for erection. Proper care shall be exercised in handling all Work so as not to injure the finished surfaces.

F. Assembly of system components shall be performed in strict accordance with the fabricator's recommendations for installation.

G. All carbon steel work shall be galvanized in accordance with Section 05 05 13.01 - Galvanizing and painted in accordance with Section 09 91 00 - Painting.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. All inserts, anchor bolts, and all other miscellaneous metal work specified and shown on the Contract Drawings or required for the proper completion of the Work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

B. All metal stair work shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. All aluminum surfaces in contact with concrete shall be given a heavy coat of bituminous paint. Aluminum surfaces in contact with other metals shall be properly isolated.

D. All galvanized and painted surfaces shall be touched up as required in accordance with the fabricator's instructions.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 52 13.05 – WELDED PIPE RAILINGS (STAINLESS STEEL)
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the requirements for stainless steel welded pipe railings. Stainless steel welded pipe railings and auxiliary system components shall be provided as specified herein and in the Contract; and as shown on the Contract Drawings. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install all stainless steel welded pipe railings.

B. Unless otherwise shown or specified, stainless steel welded pipe railings shall consist of a system of two rails welded to posts spaced no more than five (5) feet and zero (0) inches on center and a system of handrails supported from adjacent construction by mounting brackets spaced at no more than five (5) feet and zero (0) inches on center.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	8
1.09	Spare Parts, Special Tools, and Supplies	9
1.10	Warranty	9
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	10
2.03	Fabrication / Assembling / Finishes	12
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Erection	14
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	16
3.05	Adjusting / Protection / Cleanup	17

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 - Miscellaneous Metal Fastenings

B. Section 05 06 00.01 - Schedules for Stainless Steel Work

1.04 REFERENCES

A.	NYCBC	-	New York City Building Code
B.	ASTM A312	-	Seamless and Welded Austenitic Stainless Steel Pipes, Standard Specification for
C.	ASTM A554	-	Welded Stainless Steel Mechanical Tubing, Standard Specification for
D.	ASTM A666	-	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar, Standard Specification for
E.	ASTM C1107	-	Packaged Dry, Hydraulic-Cement Grout (Non-shrink), Standard Specification for
F.	ASTM E329	-	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction, Standard Specification for
G.	ASTM E488	-	Strength of Anchors in Concrete and Masonry Elements, Standard Test Method for
H.	ASTM E894	-	Anchorage of Permanent Metal Railing Systems and Rails for Buildings, Standard Test Method for
I.	ASTM E935	-	Performance of Permanent Metal Railing Systems and Rails for Buildings, Standard Test Methods for
J.	ASTM E985	-	Permanent Metal Railing Systems and Rails for Buildings, Standard Specification for
K.	ASTM F593	-	Stainless Steel Bolts, Hex Cap Screws and Studs, Standard Specification for
L.	ASTM F594	-	Stainless Steel Nuts, Standard Specification for
M.	ANSI/AWS	-	Structural Welding Code D1.1
N.	AWS A5.12	-	Tungsten and Tungsten Alloy Electrodes for Arc Welding and Cutting
O.	AWS	-	Standard Codes for Arc and Gas Welding in Building Construction

P. ANSI A1264.1 - Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings, Stairs and Guardrail/Handrail Systems

Q. 29 CFR 1910.23 - Guarding Floor and Wall Openings and Holes

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Shop inspections shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved Shop Drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples if deemed necessary, inspecting welds, verifying dimensions, and finishing inspections.

B. Manufacturer Qualifications

1. Engage a single fabricator, with undivided responsibility for detailing and performance of the stainless steel welded railing systems.

2. Engage a firm which can show minimum of five (5) years of previous successful experience in detailing and fabricating stainless steel welded pipe railing systems of similar scope and type to the required Work.

3. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency in compliance with ASTM E329 . Such inspections and tests shall not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

C. Installer Qualifications

1. Engage a single installer who is skilled, trained, and has successful and documented experience in the installation of stainless steel welded pipe railing systems, with specific skill and successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skills and successful experience in this type of work. Submit names and qualifications to the Engineer along with the following information for a minimum of three (3) successful projects:

a. Names and telephone numbers of owners, architects, or engineers responsible for projects.

b. Approximate contract costs of the stainless steel welded pipe railings.

c. Amounts of areas installed.

D. Professional Engineer

1. Engage a licensed professional engineer, registered to practice in the State of New York, and experienced in providing engineering services of the kind indicated.

2. Responsibilities include, but are not necessarily limited to, the following:

a. Carefully reviewing system performance and design criteria stated in the Contract Documents.

b. Preparing written requests for clarification or interpretation of performance or design criteria for submittal to Engineer by Contractor.

c. Preparing, or supervising the preparation of design calculations, and reviewing and approving related Shop Drawings prepared by the welded pipe railing system manufacturer prior to submission to Engineer; testing plan development and test-result interpretations; and providing comprehensive engineering analyses verifying compliance of the system with the requirements of the Contract Documents.

d. Signing and sealing all calculations and engineering analyses.

e. Certifying that:

1) It has performed the design of the welded pipe railing system in accordance with the performance and design criteria stated in the Contract Documents, and

2) The said design conforms to all applicable local, state, and federal codes, rules, and regulations and to the prevailing standards of practice.

E. Testing Agency Qualifications

1. To qualify for approval, an independent testing agency shall demonstrate to the Engineer’s satisfaction, based on evaluation of the criteria submitted by the testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work in accordance with ASTM E329.

F. Performance Criteria

1. Maintain the visual design concept shown, and the technical requirements specified, including modules, profiles, alignment of components, and requirements for finishing.

2. Contractor shall provide stainless steel welded pipe handrails and a railing system that conforms to the City of New York Building Code, ASTM E985

and CFR 29, Part 1910.23, including the two hundred (200) pound loading requirement, and including the requirement that specific types of occupancies and sizes of contributing protected areas shall incorporate greater design load resistance into the welded pipe railing system, in compliance with ASTM E985, than that specified herein.

a. Completed handrails and railings shall withstand a uniform lateral force of fifty (50) pounds per linear foot and a vertical uniform downward force of fifty (50) pounds per linear foot, both applied simultaneously at the top of the handrail and railing, performance tested in accordance with Test Method A and B of ASTM E935.

b. Intermediate and bottom rails shall withstand simultaneously applied lateral uniform forces of forty (40) pounds per linear foot and a vertical load of fifty (50) pounds per linear foot, however, lateral and vertical loads on intermediate and bottom railings need not be considered in the detailing and fabrication of posts and anchorages.

c. For railings having solid panels or picket balusters, the panels or picket balusters shall be detailed and fabricated to withstand a uniform lateral load of fifty (50) pounds distributed over any round or square area of one square foot located anywhere within the infill area or a fifty (50) pound per foot penetration cone, performance tested in accordance with Test Method C and D of ASTM E 935.

d. Concentrated two hundred (200)-pound load and uniform force conditions shall not be applied simultaneously.

e. Other pertinent requirements ceded to ANSI A1264.1 by governing authorities having jurisdiction at the Site.

f. Bending stresses shall not exceed seventy-five (75) percent of the yield stress of the material. Applied loads shall not produce permanent residual deformation in the completed Work when loads are removed. Load-deformation data shall be determined in accordance with ASTM E935.

g. Maximum allowable deflections shall be in accordance with ASTM E985.

h. Where no computations provide the needed information, then testing, in compliance with ASTM E935, shall be performed for verification that the stainless steel welded pipe railing system and auxiliary system components comply with specified performance requirements and the requirements of governing authorities having jurisdiction.

3. Thermal Control: Provide adequate expansion within the fabricated system that allows for a thermal expansion and contraction caused by a material temperature range of one hundred and forty (140) degrees Fahrenheit to negative twenty (-20) degrees Fahrenheit without warp or bow of system components. Distance between expansion joints shall be based on providing a 1/4 inch wide joint at seventy (70) degrees Fahrenheit, which accommodates a movement of one hundred and fifty (150) percent of the calculated amount of movement for the specified temperature range.

4. Provide expansion joints in handrail and railing system Work where systems cross expansion joints in structure.

5. Configuration of all stainless steel welded pipe handrails and railing systems shall be as shown on the Contract Drawings. All details shown on the Contract Drawings are typical; similar details apply to similar conditions, unless specifically noted otherwise on the Contract Drawings. Verify dimensions at the Site without causing delays in the Work.

6. Manufacturer is responsible for structural analysis and detailing of stainless steel welded pipe handrails and railing systems. Provide complete structural performance calculations and Shop Drawings for all stainless steel welded pipe handrails and railing members, anchors, and all other support system components, prepared, signed, and stamped with the seal of a licensed professional engineer registered to practice in the State of New York and recognized as an expert in the specialty involved.

G. Anchors and Supports

1. Anchorage system shall be structurally analyzed based on the results of tests in compliance with ASTM E488 and ASTM E894. Anchors shall be tested for static, seismic, fatigue, and shock loadings in series. Static tests shall include tension, shear, flexure, and torsion load resistance.

2. When the size, length, or load carrying capacity of an anchor bolt, concrete anchor, or concrete insert is not shown on the Contract Drawings, provide the size, length, and capacity required to carry the design load times a minimum safety factor of four (4) when installed in cast-in-place concrete and a minimum safety factor of six (6) when installed in unit masonry construction.

3. Sizes shown on the Contract Drawings shall be considered minimum. Increase size to comply with design loadings and minimum safety factors specified.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited, to the following:

1. Samples

    a. Full size sample, two (2) foot and zero (0) inches long, of the assembled stainless steel welded pipe railing system at post and rail intersections with all associated components, including typical welded connections, mounted toe-boards and sleeves, and handrails complete with mounting brackets, all with specified controlled uniform finish.

    b. Samples will be reviewed by Engineer for color, finish, joinery appearance, and workmanship only. Compliance with all other requirements is the responsibility of Contractor.

2. Shop Drawings

    a. Drawings for the fabrication and erection of stainless steel welded pipe railing and handrail systems with sizes of members, components, and anchorage devices, all based on specified requirements. Indicate that Shop Drawings have been reviewed by the professional engineer preparing, signing, and stamping its seal on design calculations and engineering analyses, verifying that the manufacturer's proposed fabrications, installation methods, and details adequately translate the results of the design calculations and engineering analyses into the Work, before submitting Shop Drawings to Engineer for review.

    b. Manufacturer's specifications, standard and custom detail drawings, and installation instructions and manufacturer's catalog showing complete selection of standard and custom components, auxiliary system components, and miscellaneous accessories for selection by the Engineer. Include all plans and elevations identifying the location of all railings and handrails and all expansion joints. Show all anchorage items.

    c. Profiles of stainless steel welded pipe railing and handrail system components, and the details of forming, jointing, sections, connection, internal supports, trim, and accessories. Show details of the stainless steel welded pipe railing and handrail drawn at 1-1/2 inch scale.

    d. Calculations for the complete design and engineering analysis of the stainless steel welded pipe railing and handrail system, auxiliary system components and anchorages, including calculations showing compliance with performance criteria specified, prepared, signed and stamped with the seal of a licensed professional engineer

registered to practice in the State of New York and recognized as an expert in the required Work.

3. Operation and Maintenance Manuals (O&M Manuals): Upon completion of the installation of the stainless steel welded pipe railing and handrail system, submit the following:

   a. Product name and manufacturer.

   b. Name, address, and telephone number of manufacturer and local distributor.

   c. Detailed procedures for routine maintenance and cleaning, including recommended cleaning materials, application methods, and precautions as to use of materials that may be detrimental to finish when improperly applied.

4. Certificates

   a. Copies of material purchase receipts for this Project, signed by a certified and licensed Notary Public, verifying that material purchased for the Work complies with material designations specified as confirmed by approved Shop Drawings.

   b. Furnish certification that laboratory loading tests have been performed on the handrail, railing, and anchorage systems verifying compliance with performance criteria specified, and that it conforms to all applicable CFR, ANSI, and ASTM requirements for loads and deflections and that the data derived from such tests has been used by the licensed professional engineer in the design calculations and engineering analyses of the welded pipe railing and auxiliary system components.

   c. Licensed professional engineer who prepares, signs, and stamps its seal shall provide a written statement confirming responsibility for the design and attesting that the design prepared meets the performance criteria required by the Contract Documents, the requirements of governing authorities having jurisdiction, and conforms to prevailing standards of practice.

   d. Certification of welders and welding procedures.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials

1. Deliver stainless steel welded pipe railings and handrails and all accessories dry and undamaged, with manufacturer's protective coating intact, bearing original intact factory labels.

2. Stainless steel welded pipe railing systems which are damaged during delivery or while being unloaded shall not be stored on Site. Remove such units from Site and replace panels with new, undamaged material.

B. Storage of Materials

1. Store stainless steel welded pipe railing and accessory materials in a dry location and in a manner that will protect strippable coating from exposure to sun and condensation; with good air circulation around each piece and with protection from windblown rain.

2. Store stainless steel welded pipe railing and accessory materials under tarpaulin covers and in an area protected from dirt, damage, weather, and from the construction activities of all Contractors. Do not store outside or allow items to become wet or soiled in any way while on Site.

3. Do not store in contact with concrete, earth or other materials that might cause corrosion, staining, scratching or damage to finish. Do not install system components which become dented, scratched, or damaged in any way. Remove such components from Site and replace with new, undamaged material.

C. Handling of Materials

1. Do not subject stainless steel welded pipe railing and accessory materials to bending or stress. Do not carry or transport panels in the horizontal (flat) position. Hold panels upright on edge when handling.

2. Do not damage edges or handle material in a manner that will cause scratches, warps, or dents.

3. Keep on-Site handling to a minimum.

4. Maintain protective covering on railings and handrails. System components which are damaged during installation shall be removed from Site and replaced with new, undamaged material.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Stainless Steel Mechanical Tubing: Provide the following:

1. Stainless Steel Mechanical Tubing: ASTM A554, Type 316L, annealed. Provide posts and rails with 1.90-inch outside diameter, 0.109-inch wall thickness.

2. Stainless Steel Fittings: Same material as rails except where otherwise shown on Contract Drawings.

B. Post Reinforcing Insert: ASTM A312, Grade TP316L, welded stainless steel pipe, 1.66-inch outside diameter, 0.140 wall thickness (Schedule 40S).

C. Toe-boards: ASTM A666, Type 316L stainless steel. Provide Toe-boards to the dimensions and details shown on the Contract Drawings and as follows:

1. Provide same finish as rails and handrails, securely fastened in place with not more than 1/4 inch clearance above floor level.

2. Provide for thermal expansion and contraction in Toe-boards over the entire range of temperatures specified. Thermal movement shall not cause warping or buckling of Toe-boards.

3. Toe-boards shall meet the requirements of 29 CFR, Part 1910.23, Section (e). Minimum thickness of stainless steel plate shall be 3/16-inch.

4. Toe-boards shall follow curvature of stainless steel welded pipe railing. Where stainless steel welded pipe railing is shown to have curved contours at corners, or other locations, the toe-board shall likewise be curved to follow line of stainless steel welded pipe railing system.

D. Brackets, Flanges, and Plates: Provide ASTM A666, Type 316L stainless steel brackets, flanges and plates. Components shall be selected by Engineer from manufacturer's standard and custom components. Components shall be in accordance with manufacturer's recommendations and as acceptable to Engineer as shown on approved Shop Drawings.

E. Chain, Snaps and Eyebolts: Provide oblong 0.250-inch welded link, Type 316L stainless steel chain weighing 57 pounds per cubic foot, each link 1-1/8-inch by 7/16-inch. Provide 1/4-inch threaded quick link stainless steel eye bolts with heavy-duty swivel snaps and spring loaded latches.

F. Post Sleeves: Provide the following ASTM A312, Grade TP316Lstainless steel sleeves:

1. Post Sleeves for Fixed Railing: 3.50-inch outside diameter, 0.216-inch wall thickness (Schedule 40S), 6-inch long post sleeves, as required for anchorage to concrete and masonry. Components shall be in accordance with manufacturer's recommendations and as acceptable to Engineer as shown on approved Shop Drawings.

2. Removable Railing Post Sleeves: 6-inch long, Schedule 40S post sleeves for removable railing sections. Size post sleeves for snug fit to avoid removable railing lateral movement. Provide continuous cylindrical Teflon inserts to fill annular space between sleeve and post with top cover flange flush with top of mounting surface.

G. Railing Gates: Provide the following:

1. Hinges: Provide railing gates with two self-closing hinges.

2. Latches and Stops: Provide one latch and stop with rubber bumper and 1-inch diameter plastic knob for each railing system gate shown on the Contract Drawings.

H. Accessory and Miscellaneous Materials: Provide all accessory items and system components of ASTM A666, Type 316 stainless steel, finished to match posts and rails.

I. Provide all bolts, hex cap screws and studs conforming to ASTM F593 (Alloy Group 2 composition) and all nuts conforming to ASTM F594 (Alloy Group 2 composition).

J. Concealed Connector Sleeves (Rail Splice Inserts): Provide ASTM A312, Grade TP316L stainless steel, 1.66-inch outside diameter, 0.140-inch wall thickness (Schedule 40S), minimum 5-inches long.

K. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrode as recommended by manufacturer of metal to be welded and as required for strength and compatibility of finished items.

L. Concrete and Masonry Anchors: Concrete and masonry anchors shall be as specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

1. Anchors shall be of stainless steel Type 316 and a minimum size of 1/2 inch diameter.

M. Non-Shrink, Non-Metallic Grout:

1. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and is recommended by the manufacturer for exterior use.

2. Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous, cementitious grout, complying with ASTM C1107, requiring only the addition of water at the Site.

N. Bolting Materials: As specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Provide stainless steel welded pipe railing and handrail systems completely factory fabricated using fabrication techniques recommended for stainless steel. Use tools and fabrication equipment dedicated only to the fabrication of Type 300 series stainless steels to completely eliminate ferrous contamination.

B. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the Site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Railing hall be assembled in sections as long as practicable. Posts shall be connected to flanges and fittings by welding. Surfaces of butt joints shall be ground smooth and square to obtain flush and tight joints undetectable from surrounding finish on all surfaces of the pipe.

2. On-Site welding shall not be permitted.

C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Fabricate all corners without the use of fittings. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work. Provide no less than a four (4) inch outside radius.

1. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail or railing components.

D. Cope intersections of rails and posts and weld joints. Butt weld end-to-end joints of railings or use welding connectors. Lower rails shall be coped and welded to the posts.

1. Components shall be coped at perpendicular and skew connections to provide close fit.

E. Provide for expansion and contraction in the railing system as required by performance criteria. At each side of expansion joints located in the structure to which the railing system is attached, provide an end post and railing return located sixteen (16) inches from the joint. Separation between returns shall match the width of the structure expansion joint.

F. Cut, reinforce and tap components to receive finish hardware, screws, and similar items.

G. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges and ease exposed edges to a radius of approximately 1/32 inch.

H. Provide wall returns at ends of wall-mounted handrails. Close end returns, unless clearance between end of handrail and wall is 1/4 inch or less.

1. Close ends of handrail and railing members with prefabricated end fittings.

I. Weep Holes

1. Provide 15/64 inch diameter weep holes at the lowest point on all railing system posts and along the bottom side of railing system rails.

2. Provide pressure relief holes at closed ends of handrails and railings.

J. Welding

1. Welding shall comply with the requirements of AWS D1.1 and NYCBC.

2. Provide uniformly ground, smooth and blended weldments so no roughness shows after finishing, and without visible transition to metal surfaces so that welded surface matches contours of adjoining surfaces.

   a. Welded joints shall be continuous, and made watertight.

   b. Field welding shall not be permitted.

3. All welding shall be performed with Inert Gas Tungsten Arc Welding using Direct Current, Straight Polarity. The non-consumable electrode shall be 1/16-inch diameter, two (2) percent threated tungsten electrode and have a point ground on the end similar to a pencil point. The welding current shall be between seventy (70) and one hundred (100) amperes. The shielding gas shall be argon, helium or a combination of both with a minimum flow of fifteen15 cubic feet per hour. Filler metal shall be Type 316L, stainless steel.

K. Finishes

1. All handrail, railing, exposed supports and toe-boards shall be provided with a uniform, bright, mill-polished surface obtained by finishing with a 150 - 220 mesh abrasive, following initial grinding with coarser abrasives. The finish shall be characterized by very fine parallel “grit lines” and be within a uniform range established as either an AISI No. 4 or 5 finish, with final finish established by Sample submission as approved by Engineer in compliance with Section 05 06 00.01 - Schedules for Stainless Steel Work and AISI/NIDI 9012 or AMP/NAAMM AMP 503.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Obtain all stainless steel welded pipe handrail and railing system components and accessories from the same manufacturer.

B. Provide qualified welding processes and welding operators in accordance with ANSI/AWS “Structural Welding Code” D1.1, Section 5, Qualification.

C. Provide certification that all welders employed on, or to be employed for, the fabrication of the stainless steel welded pipe rail system have satisfactorily passed

AWS qualification tests within the previous twelve months. Contractor shall ensure that all certification are kept current.

D. Allowable Tolerances:

1. Limit variation of cast-in-place inserts, sleeves and field-drilled holes to the following:

a. Spacing: ± 3/8 inch.

b. Alignment: ± 1/4 inch.

c. Plumb: ± 1/8 inch.

2. Limit variation of completed handrail and railing system alignment to 1/4 inch in 12 feet and 1/16 inch in 3 feet.

E. Set rails horizontal and parallel to rake of steps or ramps to within 1/4 inch in 12 feet.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall examine the alignment of the substrate and conditions under which the stainless steel welded pipe railing system Work is to be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the stainless steel welded pipe railing system Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Protection: Protect cast-in-place sleeves and field-drilled holes from debris and water intrusion by use of temporary covers or removable foam inserts that completely fill the cast-in-place sleeve.

C. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and installation instructions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in cast-in-place concrete or masonry. Deliver to Site in time for installation.

D. Verify dimensions by taking measurements at the Site without causing delay in the Work. Where measurements cannot be taken at the Site without delaying the Work, establish dimensions and proceed with fabrication of handrails and railings without Site measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

E. Verify gage of stainless steel welded pipe railing posts and rails brought to the Site by actual measurement of on-site material in the presence of Engineer.

3.02 ERECTION

A. Fastening to In-Place Construction

1. General: Do not erect components which have become scarred, dented, chipped, discolored, or otherwise damaged or defaced. Railing and handrail system components which have holes, cuts, gouges, deep scratches or dents of any kind shall be removed from the Site before installation. Repairs to correct such work shall not be approved by Engineer. Remove and replace with new material.

2. Posts and rail sections shall be brought into final alignment by stainless steel welded pipe railing installer.

3. Provide anchorage devices and fasteners where necessary for securing railing and handrail items to in-place construction, including threaded fasteners for concrete and masonry inserts, through-bolts and other connectors as required. Use only Type 316 stainless steel devices and fasteners.

4. Flanged fittings shall be secured to steel with nuts, bolts, and washers; to hollow glazed structural tile and masonry with masonry anchors; and to solid grouted masonry and concrete with concrete anchors. Flanges not bearing on metal shall be set in non-shrink grout.

5. Provide end posts and railing returns at sixteen (16)-inches on each side of structural expansion joints. Separation between returns shall match the width of the structural expansion joint.

6. Field-dowel connections shall be located at posts.

B. Cutting, Fitting and Placement

1. Perform cutting, drilling and fitting required for installation. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade the surface of units which have not been finished after fabrication, and are intended for field connections by mechanical or other means without further cutting or fitting.

3. Handrails supported from walls, partitions, and similar construction shall be supported by brackets located within eighteen (18) inches of handrail terminations and at intermediate points spaced not more than five (5) feet on center. Drill wall plate portion of the mounting bracket to receive one bolt, unless otherwise shown on the Contract Drawings as concealed anchorage. Provide flush-type wall-return fittings with the same projection as that shown for mounting brackets. Secure mounting brackets and wall-return fittings to building construction as follows:

a. For anchorage to concrete and solid masonry units, use concrete anchors.

b. For anchorage to hollow masonry units, use toggle bolts having square heads.

4. Make all splices as near as possible to posts but not exceeding twelve (12) inches from the nearest post. Permanent field splice connections shall be made using manufacturer's recommended minimum five (5)-inch long Type 316 stainless steel connector sleeves. Tight press-fit all field splice connectors and install in accordance with manufacturer's written instructions as provided on approved Shop Drawings.

5. Space posts five (5) feet and zero (0) inches on center and connect sections as shown on Shop Drawings approved by Engineer.

6. Expansion Joints: Provide slip joints with internal sleeve extending two (2) inches minimum beyond joint on each side. Construct expansion joints as for field splices except fasten internal sleeve securely to one side of rail assembly. Locate joints within six (6) inches of posts. Submit proposed locations of expansion joints to Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. An anchor testing program shall be established based on ASTM E488 and ASTM E894. Perform tension, shear, flexure, and shock loading resistance tests.

1. Test a minimum of one (1) anchor for every three (3) posts and one anchor for every three (3) railing supports.

2. Based on initial results of testing, test additional anchors in order to verify that design safety factors have been provided by anchor installation.

B. Anchors: Suitable equipment shall be used to perform tests required to verify correct installation of anchors and provide proof loads on anchors installed at the Site in accordance with ASTM E488 and ASTM E894.

C. The Contractor shall provide a field report on anchor testing results to Engineer, in compliance with ASTM E488 and ASTM E894, for final approval of welded pipe railing system along with recommendations for remedial work required to bring anchors up to load resistance requirements specified and required by governing authorities having jurisdiction.

D. Final payment and final approval will not be provided to Contractor until report has been approved by Engineer and remedial work is tested and shown to be in compliance with specified performance requirements.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Adjust railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction.

2. Anchor posts in concrete by means of sleeves set and anchored into concrete substrate and by side-mounting, in areas shown on the Contract Drawings. Provide closure secured to the bottom of the sleeves. Unless otherwise shown on the Contract Drawings, after the posts have been inserted into the sleeves, fill the annular space between posts and sleeves solid with non-shrink, non-metallic grout as specified. Crown grout away from posts.

3. Anchor posts to steel with stringer or support flanges, angle-type or floor-type as required by conditions, shop-connected to posts and bolted to the steel supporting members.

4. Side-mount posts by fastening them securely in brackets attached to steel or concrete and in accordance with Shop Drawings approved by Engineer.

5. At walkways and other locations where railing is provided on each side, locate railing system posts opposite each other.

B. Protection

1. Protect railing system from damage by the work of all contractors.

2. Remove defective railing system components immediately upon discovery of damage, and replace with material that meets specification requirements, so that all stainless steel welded pipe railing system components will be without damage or surface blemish at the time of Substantial Completion.

C. Cleanup

1. Clean exposed surfaces of stainless steel welded pipe railing work of every substance before leaving the Site after completion of installation. Comply with recommendations of both the stainless steel welded pipe railing and finish manufacturer. Do not use abrasives or non-approved solvent cleaners. Test cleaning techniques on an un-used section of railing before employing cleaning technique in the work.

   a. Remove protective plastic as recommended by manufacturer.

   b. Remove all stains, dirt, grease and other substances by washing railings and handrails thoroughly using clean water and soap. Rinse with clean water.

   c. Do not use acid cleaning solutions, steel wool or other harsh abrasives.

d. If stains remain after washing, remove finish and restore in accordance with recommendations of the manufacturer.

2. Leave stainless steel welded pipe railing and handrails, free from dents, burrs, scratches, holes and other blemishes. Refinish minor scratches to be indistinguishable from adjacent un-scarred areas. If, after refinishing, damage remains visible when viewed from five (5) feet away, or if finish of work has been altered to the point where it appears different from adjacent Work, Contractor shall replace damaged work with new undamaged material at no additional expense to DEP.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the requirements for aluminum pipe railing systems. Aluminum pipe railing and auxiliary system components shall conform to the requirements specified herein and in the Contract, and shall be located and configured as shown on the Contract Drawings. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install all aluminum pipe railing.

B. Unless otherwise shown or specified, aluminum pipe railing shall consist of a system of two (2) rails with totally concealed mechanical fasteners, internally threaded tubular rivets, and adhesively bonded components fastened to posts spaced not more than five (5) feet zero (0) inches on center and a system of handrails supported from adjacent construction by mounting brackets spaced at not more than five (5) feet zero (0) inches on center.

1. All aluminum pipe railing system components shall be provided with an anodized finish after fabrication, as specified herein.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	7
1.08	Delivery, Storage, and Handling	9
1.09	Spare Parts, Special Tools, and Supplies	10
1.10	Warranty	10
PART 2	PRODUCTS	10
2.01	Manufacturers	10
2.02	Materials / Equipment	10
2.03	Fabrication / Assembling / Finishes	12
2.04	Source Quality Control / Shop Tests	15
PART 3	EXECUTION	15
3.01	Examination / Preparation	15
3.02	Installation	16
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	18
3.05	Adjusting / Protection / Cleanup	18

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 - Miscellaneous Metal Fastenings

1.04 REFERENCES

A.	NYCBC	-	New York City Building Code
B.	ASTM B26	-	Aluminum and Aluminum-Alloy Sand Castings, Standard Specification for
C.	ASTM B117	-	Operating Salt Spray (Fog) Apparatus, Standard Practice for
D.	ASTM B136	-	Stain Resistance of Anodic Coatings on Aluminum, Standard Method for Measurement of
E.	ASTM B137	-	Coating Mass per Unit Area of Anodically Coated Aluminum, Standard Test Method for Measurement of
F.	ASTM B210	-	Aluminum and Aluminum-Alloy Drawn Seamless Tubes, Standard Specification for
G.	ASTM B221	-	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes, Standard Specification for
H.	ASTM B241	-	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube, Standard Specification for
I.	ASTM B244	-	Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments, Standard Test Method for Measurement of
J.	ASTM B247	-	Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings, Standard Specification for
K.	ASTM B429	-	Aluminum-Alloy Extruded Structural Pipe and Tube, Standard Specification for
L.	ASTM C1107	-	Packaged Dry, Hydraulic-Cement Grout (Non-shrink), Standard Specification for
M.	ASTM E329	-	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction, Standard Specification for
N.	ASTM E488	-	Strength of Anchors in Concrete and Masonry Elements, Standard Test Method for

O.	ASTM E548	-	General Criteria Used for Evaluating Laboratory Competence, Standard Guide for
P.	ASTM E894	-	Anchorage of Permanent Metal Railing Systems and Rails for Buildings, Standard Test Method for
Q.	ASTM E935	-	Performance of Permanent Metal Railing Systems and Rails for Buildings, Standard Test Methods for
R.	ASTM E985	-	Permanent Metal Railing Systems and Rails for Buildings, Standard Specification for
S.	ANSI A1264.1	-	Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems
T.	AA-ASD	-	The Aluminum Association, Aluminum Standards and Data
U.	AA-SAAA	-	The Aluminum Association, Standards for Anodized Architectural Aluminum
V.	AA- DAF-45	-	The Aluminum Association, Designation System For Aluminum Finishes
W.	AMP 521/NAAMM	-	Architectural Metal Products Division of the National Association of Architectural Metal Manufacturers - Pipe Railing Manual
X.	AMP 500/NAAMM	-	Architectural Metal Products Division of the National Association of Architectural Metal Manufacturers, Finishes for Aluminum
Y.	29 CFR 1910.23	-	Guarding Floor and Wall Openings and Holes

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Shop inspections shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved Shop Drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples if deemed necessary , inspecting welds, verifying dimensions, and finishing inspections.

B. Manufacturer Qualifications:

1. Engage a single fabricator, with undivided responsibility for detailing and performance of the aluminum pipe railing systems.

2. Engage a firm which can show minimum of five (5) years previous successful experience in detailing and fabrication of aluminum pipe railing systems of scope and type similar to the required Work.

3. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency in compliance with ASTM E329 and ASTM E548. Such inspections and tests shall not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

C. Installer Qualifications:

1. Engage a single installer who is skilled, trained, and has successful and documented experience in the installation of aluminum pipe railing systems and with specific skill and successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work. Submit names and qualifications to the Engineer along with the following information on a minimum of three (3) successful projects:

a. Names and telephone numbers of owners, architects, or engineers responsible for projects.

b. Approximate contract cost of the aluminum pipe railing.

c. Amount of area installed.

D. Professional Engineer:

1. Engage a registered professional engineer legally qualified to practice in the State of New York and experienced in providing engineering services of the kind indicated.

2. Responsibilities include, but are not necessarily limited to, the following:

a. Carefully reviewing system performance and design criteria stated in the Contract Documents.

b. Preparing written requests for clarification or interpretation of performance or design criteria for submittal to Engineer by Contractor.

c. Preparing, or supervising the preparation of design calculations, and reviewing and approving related Shop Drawings prepared by the aluminum pipe railing system manufacturer prior to submission to Engineer; testing plan development, and test-result interpretations; and providing comprehensive engineering analyses verifying compliance of the system with the requirements of the Contract Documents.

d. Signing and sealing all calculations and engineering analyses.

e. Certifying that:

1) It has performed the design of the aluminum pipe railing system in accordance with the performance and design criteria stated in the Contract Documents, and

2) The said design conforms to all applicable local, state and federal codes, rules and regulations and to the prevailing standards of practice.

E. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work in accordance with ASTM E329 and ASTM E548.

F. Performance Criteria:

1. Maintain the visual design concept shown, and the technical requirements specified, including modules, profiles, alignment of components and requirements for finish.

2. Contractor shall provide aluminum pipe handrail and railing system that conforms to the City of New York Building Code, ASTM E985 and CFR 29, Part 1910.23, including the two hundred (200) pound loading requirement, and including the requirement that specific types of occupancies and sizes of contributing protected areas shall incorporate greater design load resistance into aluminum pipe railing system, in compliance with ASTM E985, than that specified herein.

a. Completed handrail and railing shall withstand a uniform lateral force of fifty (50) pounds per linear foot and a vertical uniform downward force of fifty (50) pounds per linear foot, both applied simultaneously at the top of the handrail and railing, performance tested in accordance with Test Method A and B of ASTM E935.

b. Intermediate and bottom rails shall withstand simultaneously applied lateral uniform forces of forty (40) pounds per linear foot and a vertical load of fifty (50) pounds per linear foot, however, lateral and vertical loads on intermediate and bottom railings need not be considered in the detailing and fabrication of posts and anchorages.

c. For railings having solid panels or picket balusters, the panels or picket balusters shall be detailed and fabricated to withstand a uniform lateral load of fifty (50) pounds distributed over any round or square area of one square foot located anywhere within the infill area or a fifty (50) pound per foot penetration cone, performance tested in accordance with Test Method C and D of ASTM E935.

d. Concentrated two hundred (200) pound load and uniform force conditions shall not be applied simultaneously.

e. Other pertinent requirements ceded to ANSI A1264.1 by governing authorities having jurisdiction at the Site.

f. Bending stresses shall not exceed sixty (60) percent of the yield stress of the material. Applied loads shall not produce permanent

residual deformation in the completed work when loads are removed. Load-deformation data shall be determined in accordance with ASTM E935.

g. Maximum allowable deflections shall be in accordance with ASTM E985.

h. Where computations make it possible to provide the needed information, testing, in compliance with ASTM E935, shall be performed for verification that aluminum pipe railing system and auxiliary system components comply with specified performance requirements and the requirements of governing authorities having jurisdiction.

3. Thermal Control: Provide adequate expansion within the fabricated system that allows for a thermal expansion and contraction caused by a material temperature range of one hundred and forty (140) degrees Fahrenheit to negative twenty (-20) degrees Fahrenheit without warp or bow of system components. Distance between expansion joints shall be based on providing a 1/4 inch wide joint at seventy (70) degrees Fahrenheit, which accommodates a movement of one hundred and fifty (150) percent of the calculated amount of movement for the specified temperature range.

4. Provide expansion joints in handrail and railing system work where systems cross expansion joints in structure.

5. Configuration of all aluminum pipe handrail and railing systems shall be as shown on the Contract Drawings General Railing and Handrail Sheet. All details shown on the Contract Drawings are typical; similar details apply to similar conditions, unless specifically noted otherwise on the Contract Drawings.

6. Manufacturer is responsible for structural analysis and detailing of aluminum pipe handrail and railing system. Provide complete structural performance calculations and Shop Drawings for all aluminum pipe handrail and railing members, anchors and all other support system components prepared, signed and stamped with the seal of a registered professional engineer licensed to practice in the State of New York and recognized as an expert in the specialty involved.

G. Anchors and Supports:

1. Anchorage system shall be structurally analyzed based on results of tests in compliance with ASTM E488 and ASTM E894. Anchors shall be tested for static, seismic, fatigue and shock loadings in series. Static tests shall include tension, shear, flexure, and torsion load resistance.

2. When the size, length or load carrying capacity of an anchor bolt, concrete anchor or concrete insert is not shown on the Contract Drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four when installed in cast-in-place concrete and a minimum safety factor of six when installed in unit masonry construction.

3. Sizes shown on the Contract Drawings shall be considered minimum. Increase size to comply with design loadings and minimum safety factors specified.

4. All railing system posts shall be provided with a circular profile solid bar.

H. Allowable Tolerances:

1. Provide “pencil-line” thin butt joints.

2. Limit variation of cast-in-place inserts and sleeves to the following:

a. Spacing: ± 3/8 inch.

b. Alignment: ± 1/4 inch.

c. Plumb: ± 1/8 inch.

3. Minimum Railing System Plumb Criteria:

a. Limit variation of completed handrail and railing system alignment to 1/4 inch in 12 feet - 0 inches with posts set plumb to within 1/16 inch in 3 foot - 0 inches.

b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4 inch in 12 feet - 0 inches.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited, to the following:

1. Samples:

a. Full size sample, two (2) foot – zero (0) inches long, of assembled aluminum pipe railing system at post and rail intersections with all associated components including typical mechanical and adhesively fastened connections, mounted toe-board and sleeve, and handrail system at wall return complete with mounting brackets all with specified anodized finish.

b. Color Samples: Maximum range of anodized aluminum finish color variation that shall appear in finished work. Prepare range samples, to show the highest level of color control feasible for actual aluminum pipe railing and handrail system work, as determined by the licensor of the finishing process selected, on actual extrusions and castings of the work.

c. Samples will be reviewed by Engineer for color, finish, joinery appearance and workmanship only. Compliance with all other requirements is the responsibility of Contractor.

2. Shop Drawings:

a. Drawings for the fabrication and erection of aluminum pipe railing and handrail systems with sizes of members, components, and

anchorage devices, all based on specified requirements. Indicate that Shop Drawings have been reviewed by the professional engineer preparing, signing, and stamping its seal on design calculations and engineering analyses, verifying that the manufacturer's proposed fabrication, installation methods and details adequately translate the results of the design calculations and engineering analyses into the work, before submitting Shop Drawings to Engineer for review.

b. Include copies of manufacturer's specifications, standard and custom detail drawings, and installation instructions and manufacturer's catalogs showing complete selection of standard and custom components, auxiliary system components, and miscellaneous accessories for selection by Engineer. Include all plans and elevations identifying the location of all railing and handrails, and all expansion joints.

c. Profiles of aluminum pipe railing and handrail system components, and the details of forming, jointing, sections, connection, internal supports, trim, and accessories. Show details of the aluminum pipe railing and handrail drawn at 1-1/2 inch scale.

d. Calculations for the complete design and engineering analysis of the aluminum pipe railing and handrail system, auxiliary system components and anchorages, including calculations showing compliance with performance criteria specified, prepared, signed and stamped with the seal of a registered professional engineer licensed to practice in the State of New York and recognized as an expert in the required work.

3. Maintenance Manuals (O&M Manuals): Upon completion of the installation of the aluminum pipe railing and handrail systems, submit the following:

a. Product name and manufacturer.

b. Name, address and telephone number of manufacturer and local distributor.

c. Detailed procedures for routine maintenance and cleaning, including recommended cleaning materials, application methods and precautions as to use of materials that may be detrimental to finish when improperly applied.

4. Certificates:

a. Copies of material purchase receipts, for this job, signed by a certified and licensed Notary Public, verifying that material purchased for the Work complies with material designations specified as confirmed by approved Shop Drawings.

b. Furnish certification that laboratory loading tests have been performed on the handrail, railing and anchorage systems verifying compliance with performance criteria specified, and that it conforms to all applicable CFR, ANSI and ASTM requirements for loads and deflections and that the data derived from such tests has been used by the registered professional engineer in the design calculations and engineering analyses of the aluminum pipe railing and auxiliary system components.

c. Registered professional engineer who prepares, signs and stamps its seal shall provide a written statement confirming responsibility for the design and attesting that the design prepared meets the performance criteria required by the Contract Documents, the requirements of governing authorities having jurisdiction, and conforms to prevailing standards of practice.

d. Finish: Furnish a written certificate confirming specified anodized coating film thickness, coating weight, sealing treatment and stain test performance.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver aluminum pipe railing and handrail and all accessories dry and undamaged, with manufacturer's protective coating intact, bearing original intact factory labels.

2. Aluminum pipe railing systems which are damaged during delivery or while being unloaded shall not be stored on Site. Remove such units from Site and replace panels with new, undamaged material.

B. Storage of Materials:

1. Store aluminum pipe railing and accessory materials in a dry location and in a manner that will protect strippable coating from exposure to sun and condensation; with good air circulation around each piece and with protection from windblown rain.

2. Store aluminum pipe railing and accessory materials under tarpaulin covers and in an area protected from dirt, damage, weather and from the construction activities of all Contractors. Do not store outside or allow items to become wet or soiled in any way while on Site.

3. Do not store in contact with concrete, earth or other materials that might cause corrosion, staining, scratching or damage to finish. Do not install system components which become dented, scratched or damaged in any way. Remove such components from Site and replace with new, undamaged material.

C. Handling of Materials:

1. Do not subject aluminum pipe railing and accessory materials to bending or stress.
2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.
3. Keep on-Site handling to a minimum.
4. Maintain protective covering on railings and handrails. All surface protective coverings such as non-adhesive papers, adhesive papers and strippable plastic films shall be removed after receipt at the Site as soon as there is no longer a need for the protection.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Railings
   a. Custom Fabricated Connectorail System as manufactured by Julius Blum & Company, Inc., Carlstadt, NJ.
   b. Custom Fabricated Series 500 Non-Welded Aluminum Pipe Railing as manufactured by Superior Aluminum Products, Inc., Russia, OH.
   c. Or approved equal.
2. Finishes
   a. Alumilite 215 Clear as manufactured by Aluminum Company of America, Inc., New York, NY
   b. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.

B. Aluminum Forgings: ASTM B247.

C. Extruded or Drawn Aluminum Pipe and Tube:

1. ASTM B429 or ASTM B241, Alloy 6063-T5, 6063-T52 or 6063-T832 as required by loadings, deflections and post spacing's specified.

2. Provide Schedule 40 pipe minimum, unless conditions of detail and fabrication require extra heavy pipe to comply with performance criteria specified.

3. Provide all rails and posts with minimum outside diameter of 1.900-inches; nominal size of 1-1/2-inches.

D. Reinforcing Bars:

1. Solid 24-inch long 6061-T6 circular cross section aluminum reinforcing bars with outside diameter same as inside diameter of post.

E. Toe-boards:

1. Provide extruded ASTM B429 6063-T5 or T52 alloy aluminum toe-boards, unless railing is mounted on curbs or other construction of sufficient height and type to meet the requirements of 29 CFR 1910.23. Bars or plates are not acceptable and shall not be approved by Engineer.

2. Unless otherwise specified, toe-boards shall meet requirements of 29 CFR Part 1910.23, Section (e).

3. Securely fasten toe-board in place with not more than 1/4-inch clearance above floor level. Provide for thermal expansion and contraction in toe-boards over the entire range of temperatures specified. Thermal movement shall not cause warping or buckling of toe-boards.

4. Provide manufacturer's toe-board detail which accommodates storage for removable socket covers.

F. Anchors and Fastenings:

1. Type 316 stainless steel.

2. Provide minimum of four bolt fasteners per post where surface mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as acceptable to Engineer as shown on approved Shop Drawings.

3. Concrete and masonry anchors shall be as specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

4. Anchors shall be of stainless steel Type 316 and a minimum size of 1/2-inch diameter.

5. Bolting Materials: As specified in Section 05 05 23.02 - Miscellaneous Metal Fastenings.

G. Castings:

1. Provide high strength aluminum alloy brackets, flanges and fittings suitable for anodizing as specified.

2. Aluminum-Alloy Sand Castings: ASTM B26.

H. Concealed Connector Sleeves: Schedule 40, 5-inches long by 1.610-inches diameter.

I. Brackets and Flanges: Provide manufacturers complete selection of standard and custom brackets and flanges for railing posts and for handrail supports.

J. Sockets: Provide six (6)-inch deep by two and a half (2-1/2)-inch outside diameter aluminum sockets with three and a half (3-1/2)-inch wide socket cover on bottom of all sockets and on top and bottom of removable post sockets.

K. Hinges: Provide two self-closing aluminum hinges for each railing system gate.

L. Gate Latches and Stops: Provide one (1) latch and stop with rubber bumper and one (1)-inch diameter plastic knob for each railing system gate.

M. Custom Cover Flanges: Provide quarter (1/4)-inch high by four (4)-inch diameter aluminum cover flanges for all non-removal posts and three and a half (3-1/2)-inch wide by one and one eighth (1-1/8)-inch high aluminum pipe collars with quarter (1/4)-inch set screws for all removable posts.

N. Auxiliary System Components and Miscellaneous Accessories: Provide a complete selection of manufacturer's standard and custom aluminum handrail and railing components and miscellaneous accessories including, but not limited to, fascia flanges, post brackets, interlocking panel clips, clamps, end caps, post caps, adapters and similar items.

O. Adhesive: Two (2)-part waterproof epoxy-type as recommended by railing and handrail manufacturer.

P. Non-Shrink, Non-Metallic Grout:

1. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and is recommended by the manufacturer for exterior use.

2. Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous, cementitious grout, complying with ASTM C1107, requiring only the addition of water at the Site.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication

1. Unless otherwise shown or specified in the Contract Documents provide typical non-aluminum construction details and fabrication techniques as recommended by AMP/NAAMM publications specified.

2. Railings

a. Form exposed Work true to line and level with accurate angles, surfaces and straight edges. Fabricate all corners without the use of fittings. Form bent-metal corners to the radius shown without causing grain separation or otherwise impairing the Work. Form all change in handrail and railing direction with radius bends. Provide not less than four (4) inch outside radius.

1) Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive

configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail or railing components.

b. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges and ease exposed edges to a radius of approximately 1/32 inch.

c. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.

d. Locate intermediate rails equally spaced between top rail and finished floor.

e. Close aluminum pipe ends by using prefabricated fittings.

B. Weep Holes

1. Fabricate joints which will be exposed to the weather so as to exclude water.

2. Provide 15/64 inch diameter weep holes at the lowest possible point on all railing system posts.

3. Provide pressure relief holes at closed ends of handrails and railings.

C. Toe-boards

1. Provide toe-boards to the dimensions and details shown on the Contract Drawings and as follows:

a. Provide manufacturer's toe-board detail which accommodates movement caused by thermal change specified without warping or bowing toeboards.

b. Provide manufacturer’s toe-board detail which accommodates storage for removable socket covers.

c. Coordinate and cope toe-board as required to accommodate cover flanges at posts.

d. Toe-boards shall follow curvature of aluminum pipe railing. Where aluminum pipe railing is shown to have curved contours at corners, or other locations, the toe-board shall likewise be curved to follow line of aluminum pipe railing system.

D. Reinforcing Bars

1. Provide circular profile solid reinforcing bar friction-fitted at all railing system posts. Extend reinforcing bars six (6)-inches into cast-in-place sleeves or other types of supporting brackets.

E. Mechanically Fitted Component Pipe Handrail and Railing

1. Use a nonaluminum pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.

2. Provide a top and two intermediate horizontal rails, equally spaced.

3. Blind rivets, pop rivets or other exposed fastening devices shall not be used in the Work. Fasteners used for side mounting fascia flanges where shown or specified may be exposed in the Work. Provide internally threaded tubular aluminum rivets, stainless steel through bolts with lock nuts, stainless steel sheet metal screws with lock-washers and epoxy adhesive for fastening all components of the Work.

4. Provide for expansion and contraction in the railing system as required by performance criteria. At each side of expansion joints located in the structure to which the railing system is attached, provide an end post and railing return located sixteen (16) inches from the joint. Separation between returns shall match the width of the structure expansion joint.

F. Finishes

1. General:

   a. Prepare surfaces for finishing in accordance with recommendations of the aluminum producer and the finisher or processor.

   b. Adjust and control the direction of mechanical finishes specified to achieve the best overall visual effect in the work.

   c. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for all aluminum components of the work. Engineer reserves the right to reject aluminum materials because of color or texture variations, which are visually objectionable, but only where the variation exceeds the range of variations established by the manufacturer prior to the work, by means of range samples which have been accepted by Engineer.

   d. Anodize all aluminum components of the work.

2. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; Aluminum Association Designation - M32 Medium Satin Directional Texture.

   a. Hand Rubbed Finish: Where required to complete the work and provide uniform, continuous texture, provide hand rubbed finish to match medium satin directional texture specified in order to even out and blend in satin finishes produced by other means.

3. Provide non-etching chemical cleaning by immersing the aluminum in an inhibited chemical solution, as recommended by the coating applicator, to remove all lard oil, fats, mineral grease and other contamination detrimental to providing specified finishes. Clean and rinse with water between steps as recommended by the aluminum manufacturer.

4. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified which do not depend on dyes, organic or inorganic pigments, or

impregnation processes to obtain color. Apply coatings using only the aluminum alloy, temperature, current density and acid electrolytes to obtain specified colors in compliance with the designation system and requirements of the Aluminum Association and AMP 501 of AMP/NAAMM. Comply with the following:

a. Provide Architectural Class I high density anodic treatment by immersing the components in a tank containing a solution of fifteen (15) percent sulfuric acid at seventy (70) F with twelve (12) amperes per square foot of direct current for minimum of sixty (60) minutes; Aluminum Association Designation A41 - Clear (natural).

b. Physical Properties:

1) Anodic Coating Thickness, ASTM B244: Minimum of 0.7 mils thick.

2) Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.

3) Resistance to Staining, ASTM B136: No stain after 5 minutes dye solution exposure.

4) Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.

c. Seal finished anodized coatings using deionized boiling water to seal the pores and prevent further absorption.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Source Quality Control:

1. Obtain all aluminum pipe railing and handrail system components and accessories from the same manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall examine the alignment of the substrate and conditions under which the aluminum pipe railing system work is to be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the aluminum pipe railing system work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Protection: Protect cast-in-place sleeves and field-drilled holes from debris and water intrusion by use of temporary covers or removable foam inserts that completely fill the cast-in-place sleeve.

C. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and installation instructions for installing anchorages,

including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in cast-in-place concrete or masonry. Deliver to Site in time for installation.

D. Verify dimensions by taking measurements at the Site without causing delay in the work. Where measurements cannot be taken at the Site without delaying the work, establish dimensions and proceed with fabrication of handrails and railings without Site measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

E. Verify to Engineer gage of aluminum pipe railing posts and rails brought to the site by actual measurement of on-Site material in the presence of Engineer.

3.02 INSTALLATION

A. Fastening to In-Place Construction

1. General:

a. Do not erect components which have become scarred, dented, chipped, discolored or otherwise damaged or defaced. Railing and handrail system components which have holes, cuts, gouges, deep scratches or dents of any kind shall be removed from the site before installation. Repairs to correct such Work shall not be approved by Engineer. Remove and replace with new material.

b. Comply with installation and anchorage recommendations of AMP/NAAMM publications specified in addition to the requirements specified herein.

2. Posts and rail sections shall be brought into final alignment by aluminum pipe railing installer.

3. Provide anchorage devices and fasteners where necessary for securing railing and handrail items to in-place construction, including threaded fasteners for concrete and masonry inserts, through-bolts and other connectors as required. Use only Type 316 stainless steel devices and fasteners.

4. Flanged fittings shall be secured to steel with nuts, bolts and washers; to hollow glazed structural tile and masonry with masonry anchors; and to solid grouted masonry and concrete with concrete anchors. Flanges not bearing on metal shall be set in non-shrink grout.

5. Anchor posts in concrete by means of sockets and side mounted fascia flange brackets, set and anchored into the concrete floor slabs and sides of concrete walls and raised walkways. Provide closure secured to the bottom of sleeve. Before installing posts remove all debris and water from sleeves. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable railing sections, after the posts have been inserted into the sockets, fill the annular space between posts and sockets solid with grout.

6. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop connected to posts and bolted to the supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar.

7. Provide removable railing sections where shown. Removable railing posts shall be provided with friction fitted reinforcing bar in each post. Provide sockets with socket covers stored in extruded toe-board. Provide aluminum pipe collars for all removable posts. Accurately locate sleeves to match post spacing's.

8. All posts set in concrete shall be provided with an aluminum floor cover flange.

9. Provide end posts and railing returns at sixteen (16)-inches on each side of structural expansion joints. Separation between returns shall match the width of the structural expansion joint.

B. Cutting, Fitting and Placement

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade the surface of units which have not been finished after fabrication, and are intended for field connections.

3. Permanent field splice connections shall be made using manufacturer's recommended epoxy adhesive and five (5)-inch minimum length connector sleeves. Tight press-fit all field splice connectors and install in accordance with manufacturer's written instructions as provided on approved Shop Drawings. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use. Make all splices as near as possible to posts but not exceeding twelve (12) inches from nearest post.

4. Handrails supported from walls, partitions and similar construction shall be supported by brackets located within eighteen (18) inches of handrail terminations and at intermediate points spaced not more than five (5) feet on center. Drill wall plate portion of the mounting bracket to receive one bolt, unless otherwise shown on the Contract Drawings as concealed anchorage. Provide flush-type wall-return fittings with the same projection as that shown for mounting brackets. Secure mounting brackets and wall-return fittings to building construction as follows:

   a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

   b. For hollow masonry anchorage, use toggle bolts having square heads.

5. Space posts five (5) feet – zero (0) inches on center and connect sections as shown on Shop Drawings approved by Engineer.

6. Provide expansion joints with slip joint internal sleeve extending two (2) inches minimum beyond joints on each side. Fasten internal sleeve on only one (1) side of expansion joint.

7. Where details show post location requirements at or near end of runs, uniformly space intermediate posts as required to meet loading and deflection criteria specified but not greater than maximum spacing specified.

   a. At walkways and other locations where welded pipe railing system is provided on each side, locate railing system posts aligned opposite each other and with the same on center spacing.

8. Provide hinged railing sections where shown on the Contract Drawings. Provide hinges and latch for connection to adjacent railing.

9. Provide chain sections as shown. Provide one chain length with fastening accessories for top and each intermediate railing.

10. Securely fasten toe-boards in place with not more than 1/4 inch clearance above floor level.

11. Drill one 15/64 inch diameter weep hole not more than 1/4 inch above the top of location of circular profile solid reinforcing bar in each post.

12. Protection from Dissimilar Materials:

   a. Coat all surfaces of aluminum in contact with dissimilar materials such as concrete, masonry and steel as specified in Section 09 91 00 - Painting.

13. Remove coating where exposed in the finished work.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Adjust railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction.

B. Protection

1. Protect aluminum pipe railing system from damage by the work of all contractors.

2. Remove defective aluminum railing system components immediately upon discovery of damage, and replace with material that meets specification requirements, so that all aluminum pipe railing system components will be without damage or surface blemish at the time of Substantial Completion.

C. Cleaning

1. Clean exposed surfaces of aluminum pipe railing Work of every substance before leaving the Site after completion of installation. Comply with recommendations of both the aluminum pipe railing and finish manufacturer. Do not use abrasives or non-approved solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique in the Work.

   a. Remove protective plastic as recommended by manufacturer.

   b. Remove all stains, dirt, grease and other substances by washing railings and handrails thoroughly using clean water and soap. Rinse with clean water.

   c. Do not use acid cleaning solutions, steel wool or other harsh abrasives.

   d. If stains remain after washing, remove finish and restore in accordance with recommendations of the manufacturer.

2. At the completion of the work, replace adjacent Work, marred by the Work of this Section.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 05 53 01.02– STAINLESS STEEL FLOOR GRATINGS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install all stainless steel floor gratings as indicated on the Contract Drawings and specified herein.

B. Gratings shall be complete with frames, anchors, fastening devices and miscellaneous appurtenances.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.01 - Welding.

1.04 REFERENCES

A. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

C. ASTM A480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plates, Sheet and Strips.

D. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar.

E. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.

F. ASTM F594 - Stainless Steel Nuts.

G. ANSI/NAAMM MBG 531 - Metal Bar Grating Manual.

H. ANSI/NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual.

I. NAAMM MBG 533 - Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating.

J. ASTM A992 - Steel Plates, Shapes and Bars; Carbon, Structural.

K. National Association of Architectural Metal Manufacturers (NAAMM).

L. New York City Building Code (NYBC).

1.05 DESCRIPTION

A. Design Requirements

1. The design live load for grating covering floor openings shall be that designated for the adjacent floor area but not less than a uniform load of one hundred and fifty (150) pounds per square foot or a concentrated load of three hundred (300) pounds distributed over a twelve (12)-inch square area at the center of span, whichever produces the greater stress.

2. The design live load for grating on platforms shall be as designated on the Contract Drawings but not less than a uniform load of one hundred (100) pounds per square foot.

3. Grating in areas subject to vehicular traffic shall be designed for the maximum weight vehicle which can access the area. Forklifts or other similar wheeled vehicles shall have maximum wheel loads defined by the manufacturer. When wheel loads are not defined by the manufacturer, the wheel load shall be defined as forty (40) percent of the gross loaded weight of the maximum size vehicle to be accommodated.

4. The maximum allowable deflection due to dead load plus live load shall not exceed the span divided by 240, but not more than 1/4 inch.

5. Gratings shall be designed in accordance with the design criteria specified herein, and the NAAMM specifications, unless otherwise noted on the Contract Drawings or as required by the NYBC.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications of all gratings for approval by the Engineer.

B. Gratings shall not be manufactured until the Contractor's Shop Drawings have been approved by the Engineer.

C. Samples of grating and fastening devices shall be submitted for approval by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Grating

1. Ohio Gratings, Inc. Canton, OH.
2. McNichols, Tampa, FL.
3. Vulcraft, Edison, NJ.
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Type of Gratings

1. Unless otherwise shown or specified, gratings shall be one of the following types and shall be the product of one manufacturer:

a. Type "A" - Parallel bearing bars, with cross members at right angles.

b. Type "B" - Parallel bearing bars, with diagonal cross members.

B. Materials

1. Floor gratings and appurtenances shall be Type 316L Stainless Steel and shall conform to the requirements specified herein and to the following standards:

a. Gratings: ASTM A167; ASTM A480; ASTM A666

b. Frames, Curb Angles, Braces, Skirt Angles, Bolts and Fastening Devices: ASTM A276; ASTM A480; ASTM F593, ASTM F594

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Gratings shall be accurately fabricated, free from warps, twists or other defects which affect the appearance and serviceability of the grating,

B. The tops of the grating bearing bars and cross bars shall be in the same plane.

C. Gratings shall have a mill finish unless otherwise noted on the Contract Drawings.

D. All welds shall be ground smooth and conform to the requirements of Section 05 05 23.01 - Welding and NAAMM MBG 533.

E. Openings in and edges of all grating sections shall be banded with bearing bars. Bands shall be welded to all intersecting members.

F. Grating Fabrication

1. Type "A" Grating (Pressure Locked or Welded) shall consist of parallel bearing bars spaced not more than 1-3/16 inches on centers joined by cross members spaced not more than 4 inches on center (unless shown otherwise on the Contract Drawings), to form rectangular openings. Approved welded, electric-forged, slotted, friction fitted or interlocking joints shall be used in joining cross members to the bearing bars to give the grating the required strength, rigidity and durability. The distance between the support and the nearest cross bar shall not exceed two (2) inches.

2. Type "B" Grating (Welded or Riveted) shall consist of parallel bearing bars spaced not more than 1-5/16 inches on center, joined by welded or riveted bent diagonal cross bars. Rivets shall be 1/4 inch in diameter and shall be spaced not more than four (4) inches on center unless shown otherwise on the Contract Drawings. The distance between the support and the center of the nearest rivet shall not exceed one (1) inch.

3. Minimum grating depth shall be 1-1/4 inches with bearing bars not less than 3/16 inches thick.

4. Welded cross members shall not be less than 3/16 inch in thickness. Mechanically interlocked cross members shall not be less than 1/8 inch in thickness. The depth of cross members shall not be less than one-half the depth of the bearing bars, but such depth need not exceed one (1) inch.

Riveted cross members shall be as specified for mechanically interlocked cross members.

5. Serrated grating shall be provided where shown on the Contract Drawings. Depth of serrated grating shall be not less than ¼ inch greater than required standard bar grating.

6. Each section of grating shall be sized to weigh a maximum of one hundred (100) pounds unless noted otherwise on the Contract Drawings.

G. Grating Cut-outs

1. Cut-outs shall be provided in the grating for the passage of pipe, valve stems, columns and similar work. Where more than two bearing bars are included in the cut-out, banding bars of the same dimensions as the bearing bars shall be provided around the opening and welded or electric-forged to the component parts of the grating.

H. Grating Stair Treads and Landings

1. Grating stair treads shall be 1 inch wider than tread widths shown on the Contract Drawings and shall be securely fastened to angles or carrier bars which in turn shall be fastened to stringers. The outer edge or nosing of stair treads shall be so constructed as to make it distinctly visible and contrasting with the other part of the tread. Non-slip nosings shall be furnished on all the stair treads and landings.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements

1. The Contractor shall check all dimensions in the field after all piping and equipment are set in place and determine the exact dimensions and locations of openings and cut-outs.

2. Templates shall be made where required for location and size of openings and cut-outs.

3. The Contractor shall field verify all pertinent dimensions prior to grating fabrication.

3.02 INSTALLATION

A. Installation

1. Gratings shall be installed with each section readily removable and replaceable. Adjacent units shall be neatly fitted together.

2. The clearance at the ends or between sections of gratings shall be a maximum of 1/4 inch.

3. Tops of gratings shall be set flush with surrounding construction.

4. Gratings shall be set with a full and uniform end bearing on the stainless steel frames to preclude rocking movement; wedges or similar shimming devices shall not be used.

B. Fastening Devices

1. Approved fastening devices shall be installed to hold the gratings rigidly to the supports with means for easy removal.

2. Fastening devices shall not protrude above the walking surface of the grating.

3. Fasteners shall be installed in accordance with the manufacturer's recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 05 56 00.01 – MISCELLANEOUS METAL CASTINGS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor and materials as shown, specified, and required, to furnish and install all miscellaneous metal castings, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 - Painting.

1.04 REFERENCES

A. ASTM A47 Ferritic Malleable Iron Castings

B. ASTM A48 Gray Iron Castings

C. ASTM A536 Ductile Iron Castings

D. ASTM B584 Copper Alloy Sand Castings for General Applications

1.05 DESCRIPTION

A. Miscellaneous metal castings shall include all miscellaneous ferrous and non-ferrous castings to be furnished and installed by the Contractor.

B. Included in this classification are manhole frames, covers and grades, stop plank grooves, cast iron brackets or other cast iron supports for piping, floor drains, traps, cleanouts, special malleable iron castings and inserts and other special castings of any nature or material, and all necessary bolts, nuts, washers, gaskets and other appurtenances required to join sections of castings.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Submit Shop Drawings and material specifications for all castings furnished as part of the Work.

1) Shop Drawings shall be submitted under separate cover for each type of casting.

2) If a metal casting is a component or part of Work specified or shown elsewhere:

a) The Contract may elect to include the submittal information for the metal casting required herein under that separate submittal.

b) If the Contractor elects to include the metal casting submittal as part of another submittal, the Contractor shall submit a stand-alone, separate informational submittal for the metal casting indicating as such.

2. Information Submittals:

a. Certificate of conformance to applicable reference standards.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Iron Castings

1. Castings shall be as manufactured by:

a. Neenah Foundry Company, Neenah, WI

b. Campbell Foundry, Harrison, NJ

c. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Design Requirements

1. Castings exterior to structures shall be designed for an AASHTO H-20 truck loading, unless otherwise noted on the Contract Drawings.

2. Interior castings shall be designed for the loading designated on the Contract Drawings for the adjacent floor area. If no loading is designated, castings shall be designed for a minimum load of three hundred (300) pounds per square foot or as required for their intended use.

B. Metal castings shall conform to the requirements specified herein and to the following standards:

1. Gray Iron: ASTM A48

2. Ductile Iron: ASTM A536

3. Malleable Iron: ASTM A47

4. Manganese Bronze: ASTM B584

C. Where these metals are designated by class, grade, type, alloy, temper or coating, they shall conform to the requirements specified herein or as shown on the Contract Drawings.

D. Iron Castings

1. Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets; and stop log grooves.

a. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.

b. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.

2. Covers and Grates

a. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.

b. Round covers and frames shall have machined bearing surfaces.

c. Design loadings:

1) Where located within a structure, a minimum design loading of three hundred (300) psf shall be used, unless noted otherwise.

2) At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.

d. Manhole frames and covers and grates shall be Class 35 unless otherwise specified in the Contract.

3. Pier cleats, bollards, and machinery castings shall be Class 20 or 25.

4. Ductile iron castings shall be grade 80-55-06 unless otherwise specified in the Contract.

E. High Strength Yellow Brass: Commercial designation for this alloy is leaded manganese bronze and castings shall conform to the requirements of ASTM B584, copper alloy UNS No. C86500 or C86700.

F. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Castings shall be true to pattern in form and dimensions without sharp unfiltered angles or corners, free from pouring faults, sponginess, cracks, blowholes and other defects in positions affecting their strength.

B. All castings shall be made accurately to the dimensions shown on the Contract Drawings and shall be planed or ground where marked or where otherwise necessary to secure perfectly flat and true surfaces. Allowance shall be made in patterns so that specified thicknesses will not be reduced.

C. Manhole covers and floor plates shall conform to the details shown on the Contract Drawings or in their absence to the standards of the Department of Environmental Protection and shall be true and seat evenly at all points.

D. Catalog numbers indicated on the Contract Drawings are given to show required types and configurations. All covers shall be cast with raised letters as designated on the Contract Drawings.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install products in complete accordance with the manufacturer's printed instructions and the approved shop drawings. In addition:

1. All castings shall be erected to accurate grades and alignment and when placed in concrete or other surrounding materials, shall be carefully supported to prevent movement during placement of concrete or other materials.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting of scratched or damaged surfaces, using primer, intermediate, and finish paints provided by the manufacturer, in accordance with the requirements of this Section and Section 09 91 00 – Painting. In addition:

1. Non-ferrous castings shall be painted only when specifically required in the Contract.

2. Outdoor manhole frames and covers and grates are not required to be painted.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all metal castings complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	8
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	12
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Erection	14
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

1. Section 05 56 00.01 – Miscellaneous Metal Castings
2. Section 09 91 00 – Painting

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	NDE	Non Destructive Evaluation

B. Definitions:

1.	Heat:	The total molten metal output from a single heating in a batch melting process or the total molten metal output from essentially a single heating in a continuous melting operation using basically constant charge and processing conditions and targeted at a fixed metal chemistry at the furnace spout (a heat is a unique material batch.).

C. Reference Standards:

1.	ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
2.	ASTM A380	Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
3.	ASTM A609	Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof
4.	ASTM A802	Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
5.	ASTM E8	Standard Test Methods for Tension Testing of Metallic Materials
6.	ASTM E94	Standard Guide for Radiographic Examination
7.	ASTM E125	Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings
8.	ASTM E165	Standard Test Method for Liquid Penetrant Examination
9.	ASTM E305	Standard Practice for Establishing and Controlling Spectrochemical Analytical Curves
10.	ASTM E351	Standard Test Methods for Chemical Analysis of Cast Iron--All Types
11.	ASTM E433	Standard Reference Photographs for Liquid Penetrant Inspection

12.	ASTM E689	Standard Reference Radiographs for Ductile Iron Castings
13.	ASTM E709	Standard Guide for Magnetic Particle Examination
14.	ASTM E802	Standard Reference Radiographs for Gray Iron Castings Up to 4½ in. (114 mm) in Thickness
15.	MSS-SP55	Quality Standards for Steel Castings, Visual Method for Evaluation of Surface Irregularities

1.05 DESCRIPTION

A. Metal castings shall include all ferrous and non-ferrous metal castings to be furnished and installed by the Contractor, except as noted below.

1. Included are cast metal components for equipment shown or specified in the Contract Documents (such as valves, pumps, sluice gates, pipes, flanges, etc.).

2. Excluded are items specified in Section 05 56 00.01 - Miscellaneous Metal Castings, or items as noted in the Contract Documents.

B. Metal Castings shall be designed for the tensile strength, hardness, dimension, microstructure, surface finish, etc. designated in the Contract Documents and/or the applicable reference standards as required for their intended use.

1. In cases of conflict between the Contract Specifications and reference standards, the more stringent requirements shall be applicable, as determined by the Engineer.

C. All castings shall conform to the compositional requirements for named elements in the applicable reference standards and/or Contract Documents.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Engineer or by the Engineer’s representatives. The Contractor shall give notice as required to the Engineer prior to the beginning of any casting work so that inspection may be scheduled and performed. The Contractor shall furnish all facilities and equipment required for the inspection of materials and workmanship in the shop. The Contractor shall provide all approved Shop Drawings as deemed necessary by the Engineer to conduct the shop inspections. The inspectors shall be allowed free access at all times, to all parts of the manufacturers' plants where relevant manufacturing operations, inspections, and tests are being performed.

B. Inspectors shall have the authority to reject any materials or Work which does not fully meet the requirements of the Contract Documents or approved Shop Drawings.

C. Inspection at the shop is intended as a means of facilitating the Work by early identification of non-conformances; it is expressly understood that inspection does

not in any way relieve the Contractor from its responsibility to furnish proper materials and workmanship under the Contract Specification.

D. The Contractor shall meet all the specified requirements including, but not limited to: hardness, chemical composition, physical properties, microstructure, pressure tightness, radiographic soundness, magnetic particle inspection, dimensions, and surface finish, as set forth in the Contract Documents and reference standards. In cases of conflict between the Contract Documents and reference standards, the more stringent and/or costly requirements shall be applicable, as determined by the Engineer.

E. The surface of the metal castings shall be free of adhering refractory, sand, scale, cracks and hot tears. Other surface discontinuities shall meet either Level II Acceptance Criteria of ASTM A802 or the acceptance standards of MSS-SP55.

F. Traceability requirements applicable to both castings and machining shall be as follows:

1. For component items designated by the Engineer at the time inspection instructions are issued as requiring material traceability, material traceability codes shall be permanently applied to the component and annotated on test reports for each individual heat/heat treatment of material supplied.

    a. Traceability marking shall be a foundry heat number to maintain complete traceability of each unique material batch to the Certified Material Test Reports provided. Traceability shall be maintained throughout all process operations, including any subcontracted operations, to the finished component.

    b. Traceability codes shall be raised cast letters for cast items or, for machined items, shall be indelible markings made by engraving, etching, or stamping.

    c. The code shall be readily accessible and shall not be in an area that may be removed or hidden during machining, assembly, or service.

    d. The traceability code shall be designated on all component certification documents, thus allowing complete component to material certification traceability.

    e. Where marking of individual component parts is not possible due to size, the traceability code shall be clearly marked on all packaging.

    f. Material traceability of cast materials to original heat numbers shall be maintained throughout all stages of manufacture.

        1) Unless otherwise approved by the Engineer, the size of the heat numbers cast into the surface and shall be 1-in. high × ⅛-in. thick.

2) In castings where the size and/or configuration do not allow for this size to be used, all lettering/numbers shall be of approved height and thickness so that legibility of original markings is maintained after final coatings are applied.

g. Representative samples from each heat shall be provided for the components and identified to ensure traceability back to the heat. Identification of the sample shall include as a minimum the unique material heat number (batch code), relevant component part name and number, name of supplier/manufacturer, and date of manufacture. Heat numbers shall be cast on the body of the samples.

2. Except as noted herein below and/or except if explicitly shown otherwise on the Contract Drawings, in addition to the traceability code:

a. All castings shall also have "NYCDEP" cast into the surface.

b. Unless otherwise approved by the Engineer, the size of the "NYCDEP" logo shall be a minimum of 1-in. high × ⅛-in. thick, and located in a conspicuous location.

c. Any and all rejected castings shall have the "NYCDEP" designation ground off in the presence of the DEP inspector,

d. The "NYCDEP" designation shall not be used on any castings not specifically intended for a particular NYCDEP order.

1) Any manufacturer and/or foundry using the "NYCDEP" designation for work that is not part of an NYCDEP order may be subject to rejection of current work and/or disqualification from future work.

e. The following shall not have "NYCDEP" cast into the surface, and instead shall be cast as per the latest edition of the NYCDEP Sewer Design Standards and/or the Contract Documents:

1) Manhole covers.

2) Curb gratings and curb pieces.

3) Catch basin hoods.

G. Representative samples and certified material test reports indicating physical properties and chemical composition are required for all major components identified by the Engineer. Three (3) samples of approved size to produce standard specimens per the specified material designation for tensile testing shall be provided for each heat. Samples shall be sent, as soon as possible, from the foundry directly to the NYC DEP or to a location designated by the Engineer.

H. As a minimum, the Engineer or its representatives may elect to perform inspection activities during foundry pour operations, including but not limited to:

1. Assessing pattern condition prior to mold preparation (visually inspect for defects such as dents, cracks, chips, etc.).
2. Assessing sand condition.
3. Assessing mold and core condition prior to assembly procedures.
4. Reviewing molding and casting processes (e.g. sand mold).
5. Reviewing resin type, mold coating ("mold wash") type, and core reinforcement.
6. Reviewing melting and casting procedures.
7. Reviewing chemical requirements.
8. Reviewing heat treatment procedures (note: test samples shall be subjected to the same thermal treatment as the castings they represent).
9. Witnessing Chemical Analysis:
    a. Initial ladle analysis to determine correct charge (ladle chemical composition).
    b. Chemical analysis of tensile test bars or chemical coupons.
10. Witnessing Testing for Mechanical Properties:
    a. Testing of tensile test specimens machined from keel or Y-block for mechanical properties including ultimate strength, yield strength, elongation, hardness, impact, transverse bend, and microstructure, as applicable, per Contract Documents, and applicable reference standard requirements. (Note: Tensile test bars shall be poured after filling the mold and shall be from the same ladle and subjected to the same heat treatment, if applicable, as the castings they represent.)
11. Performing visual inspection of castings:
    a. Dimensional verification per Shop Drawings and visual inspection for defects such as metallic projections, shrinkage cavities, incomplete casting, inclusions, porosity, slag, discontinuities, etc.
    b. Verify that stainless steel castings have been cleaned, descaled and passivated.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to the following:

1. Action Submittals:
    a. Weld procedure specifications and supporting procedure qualification records; if permission for welding repair is granted by the Engineer.

b. Procedures (with acceptance criteria) for the non-destructive evaluation of castings and welds: visual, ultrasonic, liquid penetrant, magnetic particle, and radiographic, as applicable.

c. Representative samples of cast components as required by the designated material specification for independent chemical and physical verification testing.

2. Information Submittals:

a. Certified Material Test Reports.

b. Heat Treatment Certification and Heat Treat Charts.

c. Results of Certified Shop Tests.

d. Complete records of all additional tests and inspections shall be submitted for review and acceptance by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation and packing of the cast metal for shipment shall be in accordance with the manufacturer's commercial practice subject to the approval of the Engineer.

2. The packaging and marking shall be adequate to identify the contents and to ensure acceptance and safe delivery to the Site.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Metal castings shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

2. Metal castings shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Store packaged materials in manufacturer's unopened containers, marked with manufacturer's name and product brand name.

a. Immediately reseal containers after partial use.

4. Metal castings shall not be placed in or on a structure in a manner that might cause distortion or damage to the material.

5. The Contractor shall repair or replace damaged metal castings as directed by the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metallic polymer type repair products:

1. Belzona Industrial Protective Coatings and Composites as manufactured by Belzona New York LLC, Glen Cove, NY.

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Metal castings shall conform to the requirements of the material specified in the Contract Documents.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Mechanical Properties:

1. Sound casting practices shall be maintained to meet the necessary tensile strength, yield strength, elongation and hardness requirements of the cast metal.

2. Mechanical property requirements of the metal castings shall be as stipulated in Contract Documents and/or referenced standards, where the more stringent requirement shall be applicable.

B. Pour Time:

1. Ductile iron castings shall be poured within fifteen (15) min. of the inoculation/nodularization process to avoid fading of the inoculant.

2. Any casting poured more than fifteen (15) min. after inoculation/nodularization treatment may be subject to rejection.

3. All representative samples shall be poured from the same ladle immediately after the castings have been poured, and shall not contain bottom sediments.

C. Integrity of Castings:

1. Castings shall be true to pattern in form and dimensions without sharp unfilled angles or corners, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength.

2. Castings shall be made accurately to the dimensions shown on the Contract Drawings and shall be machined to secure perfectly true surfaces. Allowance shall be made in patterns so that specified thicknesses will not be reduced as a result of machining.

3. Plugging and filling will not be allowed where the physical strength of the casting will be impaired.

   a. Where the Engineer decides that plugging and filling will not impair the strength of the casting, the casting may be plugged and filled only upon written permission from the Engineer.

   b. Superficial non-structural cracks and small defects can be repaired subject to the Engineer's approval with approved metallic polymer type repair (filler) products.

4. All castings shall be thoroughly cleaned, inside and outside, free from adhering refractory, sand, scale, non-metallic inclusions (such as ceroxides and slag), cracks and hot tears.

   a. Wire brushes, scrapers or other approved mechanical appliances shall be used for this purpose.

   b. Acid or other corrosive liquids shall not be used in cleaning castings (except stainless castings).

5. Minimum wall thickness of castings shall be as specified in the designated equipment specification. When wall thickness tolerances are not included in the designated specification, tolerances shall be as follows:

   a. For metal castings with a nominal wall thickness less than 0.8-in., the wall thickness shall not be 0.08-in. less than the nominal wall thickness nor 0.12-in. greater than the nominal wall thickness.

   b. For metal castings with a nominal wall thickness 0.8-in. or greater, the wall thickness shall not be ten (10) percent less than the nominal wall thickness nor fifteen (15) percent greater than the nominal wall thickness.

   c. However, acceptable deficiencies in wall thickness shall not exceed one half the area of any casting.

D. Visual Acceptance: The surface of the metal castings shall be free of adhering refractory, sand, scale, cracks and hot tears. Other surface discontinuities shall meet either Level II acceptance criteria of ASTM A802 or the acceptance standards of MSS-SP55.

1. Defects that exceed the acceptance limits may be ground down and blended into the surrounding metal, provided it is meets the minimum wall thickness requirements.

E. Weld repair is not permitted for cast iron or ductile iron. For other materials, no repair of surface defects by welding, plugging, brazing, filling, impregnation, etc., shall be permitted where the physical strength of the casting will be impaired. Additionally, no such repairs shall be permitted without the prior approval of the Engineer, in writing. Castings which have been repaired prior to receiving approval from the Engineer will be subject to rejection. If the manufacturer believes a casting may be repaired by welding, he shall excavate all defects to sound metal by a method approved by the Engineer and verify removal of the defect with PT, MT, or RT (as directed and approved) in the presence of the DEP inspector. He shall then prepare a defect map which identifies all defects by final size (surface dimensions and depth) and location. The defect map, repair procedure, and post repair evaluation procedure shall be submitted to the Engineer for approval.

F. If permission for repair by welding is granted by the Engineer, the amount and type of NDE and acceptance criteria to be performed on the weld repairs of the castings shall be as approved by the Engineer. All weld repairs shall be preheated per approved Welding Procedure Specification (WPS) and repaired castings shall be post weld heat treated. The acceptance criteria for such NDE of weld repairs shall be as follows:

1. Acceptance Criteria for Radiographic Tests: The following weld defects shown by radiography shall be unacceptable:

   a. Any cracks, linear indications, or zone of incomplete fusion or incomplete penetration.

   b. Any elongated indication which has a length greater than:

      1) ¼-in. (6.4mm) for weld thicknesses up to ¾-in. (12.7mm),

      2) ⅓-T for weld thicknesses from ¾-in. to 2¼ in., or

      3) ¾-in. for weld thicknesses over 2¼-in.

      4) Note: Indications not characterized as being a crack or zone of incomplete fusion or penetration shall be evaluated as being elongated indications if the length is three or more times the width.

   c. Any group of aligned indications per 6 in. (152mm) of weld length greater than

      1) ½-in. (12.7mm) for weld thicknesses up to ½-in.

      2) 1-in. (25.4mm) for weld thicknesses ½-in. or greater.

   d. Any rounded indications exceeding ⅛-in. (3.2mm) in diameter.

   e. Any group of rounded indications with diameters $^{1}/_{32}$ in. (0.8mm) or greater, when the sum of their diameters exceeds ¼-in. (6.4 mm) per square in. (645 mm2).

2. Acceptance Criteria for Magnetic Particle and Dye Penetrant Tests: All surfaces to be examined shall be free of:
    a. All linear indications.
    b. Rounded indications greater than $^{3}/_{16}$ in.
    c. Four or more rounded indications greater than $^{1}/_{16}$-inch in a line separated by $^{1}/_{16}$ in. or less (edge to edge).
3. Acceptance Criteria for Visual Tests: All weld surfaces to be examined shall:
    a. Be free of crater cracks or surface cracks.
    b. Have complete fusion and required penetration between the weld metal and the base metal.
    c. Have undercut not exceeding $^{1}/_{32}$ in.
    d. Have excess reinforcement not exceeding $^{1}/_{64}$ in.

G. Heat Treatment: Castings requiring heat treatment to improve their mechanical properties shall be carried out in accordance with the product material specifications or by written permission from the Engineer. Metal castings shall be heat-treated by full annealing, normalizing, normalizing and tempering, or quenching and tempering. Unless otherwise specified in the Contract Documents, the castings may be heat-treated by any one or combination of these heat treatment processes.

1. Heat treatment shall be performed after castings have been allowed to cool from the pouring temperature to below the transformation range.
2. Furnace temperatures for heat treating shall be regulated by the use of pyrometers.
3. Heat treatment certification report shall be submitted to the Engineer.
4. Heat Treatment Certification shall include:
    a. The material traceability code of the heat-treated item
    b. The preheat treatment material batch number (heat lot #)
    c. Heat treatment batch number
    d. Date of heat treatment
    e. Process type
    f. Process temperature
    g. Process duration
    h. Quenching details
    i. Heat treatment temperature chart

j. Measured surface hardness (and test method)

k. Post heat treatment CMTRs (Certified Material Test Reports)

H. Painting:

1. Where metal castings are required to be painted, such work shall be done in accordance with Section 09 91 00 - Painting. Painting of stainless steel castings is not permitted.

I. Descaling, Cleaning and Passivation of Stainless Steel Castings

1. Stainless steel castings shall be descaled, cleaned and passivated and shall show no rust spots when tested by the Water Wetting and Drying method of ASTM A380 or no free iron indications when tested by the Copper Sulfate Test method of ASTM A380.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. General:

1. All tests required by the Contract Specifications shall be performed by a NYCDEP approved Testing Laboratory whose services have been contracted by the manufacturer.

a. Complete records of all tests and inspections shall be maintained by the manufacturer. The supplier shall monitor and measure the characteristics of the product to verify that the product requirements as specified on component drawings and Contract Documents, including hardness, where applicable, have been met.

b. Records demonstrating compliance with the acceptance criteria shall be maintained, and the records shall indicate the person(s) authorizing the release of the product.

c. A casting log shall also be maintained.

1) The information contained in the casting log shall include, quantity poured, part description, casting serial number, foundry heat number, heat treat number, material designation, material type, material properties, hardness and percent nodularity if applicable.

2. In the event of a disparity between the manufacturer's test results and the NYC DEP's verification test results or should the manufacturer's test results be deemed questionable by the Engineer, the NYCDEP reserves the right to require retesting or additional "referee" testing at an approved testing laboratory.

B. Mechanical Testing: Mechanical testing of the castings shall comply with the sampling methods, dimensional requirements, number of tests and retests, etc. as per the referenced standards, the Contract Drawings and the Contract Specifications.

1. Tensile Tests shall be performed in accordance with the requirements of the individual product specification. If the product specification does not provide requirements for testing, ASTM E8 with definitions provided by ASTM A370 shall be used. Except as otherwise specified in the Contract Documents, one tension test shall be performed on each heat.

2. Hardness measurement at the specified locations on the castings, or as designated by the Engineer, shall be made in accordance with the applicable ASTM or approved standard.

C. Non-Destructive Testing (NDE): Non-Destructive testing shall be performed per the requirements of the referenced standards, the Contract Drawings and the Contract Specifications.

1. Magnetic Particle Testing (MT) shall be performed in accordance with the requirements of ASTM E709. The type and degrees of discontinuities considered shall be judged by reference photographs in ASTM E125 for ferrous castings; and the basis of acceptance shall be Severity Level 2 or better for any type of discontinuity.

2. Radiographic Examination (RT) for internal defects shall be performed in accordance with ASTM E94. In these cases, radiographic examination of the castings may be performed before or after any heat treatment. The type and degree of discontinuity shall be judged by the applicable reference radiographs. The basis of acceptance shall be Severity Level 2 or better for any type of discontinuity as referenced by ASTM E689 or E802, as applicable.

3. Liquid Penetrant examination (PT) for surface discontinuities shall be performed in accordance with ASTM E165. The type and class of surface discontinuity indications shall be judged by reference standard ASTM E433. Penetrant indications of surface discontinuities shall be accepted or rejected based on the severity level of surface discontinuities in the zones of inspection, and the indicated depth of such discontinuities. Linear defects revealed by liquid penetrant inspection shall be explored by grinding or other suitable means approved by the Engineer. Depth of defects shall not exceed the dimensional tolerance of the material.

4. Ultrasonic Inspection (UT) for internal defects shall be carried out in accordance with ASTM A609. Ultrasonic examination of castings shall be performed after at least one heat treatment above the critical temperature but need not be repeated after subsequent heat treatment. Acceptance standards shall be as designated in the Contract Documents and the relevant reference standards.

5. The technicians carrying out these tests should be American Society for Nondestructive Testing (ASNT) Level I or II certified in the appropriate

practice. However, for individuals interpreting test results, a minimum ASNT Level II certification is required.

D. Chemical Testing: The chemical composition of the heat shall be controlled such that the required metallurgical phase(s) and elemental contents shall conform to the compositional requirements for the named elements as specified in the Contract Documents and the relevant reference standards. A product analysis shall be made from material representing each heat. Spectrographic or other methods such as those specified in ASTM E305 and E351 may be used for chemical analysis.

E. Re-certification of material is required when material is subjected to a heat treatment process that alters its properties. All material samples shall be heat treated along with the component parts they represent. When only the mechanical properties are altered, the original certification for chemical composition shall be over-stamped and/or annotated with the unique material traceability code used with the altered material physical properties.

F. Unless otherwise approved, hydrostatic tests on cast components containing pressure boundaries (casting across which a pressure differential can or will occur while in service) shall be performed after shakeout cleaning and/or machining but prior to surface preparation and coating of the surfaces. The cast component shall be under the full test pressure at a minimum of two (2)-times the rated pressure or one and a half (1½)-times the maximum service condition (whichever is greater) or as designated in the applicable reference standards for the duration of the hydro test. Any casting that leaks or does not withstand the test pressure shall be rejected. The hydro test report shall be traceable to the item tested and shall accompany all shipment made against the purchase order. The test report shall include supplier's name, test fluid temperature, hold time, pressure, and procedure number.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used.

3.02 ERECTION

A. All castings shall be assembled and erected to accurate grades and alignment and, when placed in concrete or other surrounding materials, shall be carefully supported to prevent movement during placement of concrete or other materials.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 05 59 16 – FABRICATED METAL ACCESS HATCHES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, fabricate, and install aluminum and stainless steel fabricated metal access hatches as shown on the Contract drawings and specified herein. The hatches shall be provided, complete with all accessories and fastenings required for a complete and operational installation.

1. Access hatches shall be installed horizontally and used for access in floors or decks and have a hinge cover with springs, hold-open arms, locking mechanism and a fall protection system.

B. Fabricated metal access hatches specified herein shall include sidewalk, roadway, and floor access hatches that are intended to be mounted into cast concrete.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A.	Section 01 43 10	-	Quality Assurance Inspection
B.	Section 05 06 00.01	-	Schedules for Stainless Steel Work
C.	Section 05 05 13.01	-	Galvanizing
D.	Section 05 05 23.01	-	Welding
E.	Section 05 05 23.02	-	Miscellaneous Metal Fastenings
F.	Section 05 12 00	-	Structural Steel Framing
G.	Section 05 50 00	-	Metal Fabrications
H.	Section 05 52 13.05	-	Welded Pipe Railings (Stainless Steel)
I.	Section 09 91 00	-	Painting

1.04 REFERENCES

A.	AAMA 611	-	American Architectural Manufacturers Association Specification for Anodized Architectural Aluminum
B.	ASTM B209	-	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C.	ASTM A240	-	Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
D.	ASTM A262	-	Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
E.	ASTM A276	-	Specification for Stainless Steel Bars and Shapes
F.	ASTM A313	-	Specification for Stainless Steel Spring Wire
G.	ASTM A480	-	Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plates, Sheet and Strips
H.	ASTM A666	-	Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
I.	ASTM B221	-	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
J.	ASTM B308	-	Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
K.	ASTM B632 / B632M	-	Specification for Aluminum-Alloy Rolled Tread Plate
L.	ASTM C1802	-	Standard Specification for Design, Testing, Manufacture, Selection and Installation of Fabricated

Metal Horizontal Access Hatches for Utility, Water and Wastewater Structures

M. ANSI/AWS D1.1 - Structural Welding Code – Steel

N. ANSI/AWS D1.2 - Structural Welding Code – Aluminum

O. ANSI/AWS D1.6 - Structural Welding Code – Stainless Steel

P. New York City Building Code (NYCBC)

1.05 DESCRIPTION

A. The Contractor shall supply Fabricated Metal Access Hatches as follows:

1. Type 1 – ASTM C 1802 Load Level 1 – Light Pedestrian Load
    a. Intended for use in areas restricted to pedestrians that are totally inaccessible to all vehicle traffic.
    b. A design loading of 150 PSF and a concentrated design load of 300 LBF is required.
    c. Deflection shall not exceed the lesser of the span divided by 200 or 3/16 inch.
2. Type 2 – ASTM C 1802 Load Level 2 – Pedestrian Load
    a. Intended for use in areas restricted to pedestrian that are totally inaccessible to all vehicle traffic.
    b. A design loading of 300 PSF and a concentrated design load of 600 LBF is required.
    c. Deflection shall not exceed the lesser of the span divided by 200 or 3/16 inch.
3. Type 3 – ASTM C 1802 Load Level 5 – Off Street Truck Traffic
    a. Intended for use in unrestricted parking access lanes and alleyway where the traffic speed is limited to 15 mph.
    b. A concentrated design load of 16,000 LBF plus a 30% dynamic (impact) allowance – H20 loading is required.
    c. Deflection shall not exceed the lesser of the span divided by 300 or 3/16 inch.
4. Heavy duty access hatches designed to withstand wheel loading in excess of H20 loading and suitable for use in locations subjected to high density traffic or heavier loading applications shall meet the requirements of ASTM C 1802 Load Levels 6, 7, 8, 9 or 10.
5. Access hatch types other than ones listed in this Specification shall be as indicated in the Contract Documents.

B. Access hatch sizes shall be as shown on the Contract Drawings.

C. Covers shall be equipped with hold-open arm(s), springs, hinges and locking mechanism.

D. Lifting Mechanism:

1. Access hatches shall be designed to provide the proper amount of lift assist to assure access hatch cover(s) can be opened by one person with no more than 35 pounds of vertical lifting force.

E. Fall Through Protection

1. All access hatches shall have permanent means of fall protection complying with OSHA 29 CFR 1910.23 and NYCDEP EHS.

a. Furnish and install fall protection grating system on access doors, where indicated on the Contract Drawings, fall protection grating system. The grating system shall be fabricated as part of the access hatch assembly.

b. Fall through protection shall consist of fiberglass or aluminum grating panel(s), lift assist, hold open arm and hardware, and locking mechanism.

2. Removable Safety Barrier Chains

a. Stainless steel safety chains with latches shall be provided and attached to the railing system for additional safety.

3. Safety Railings

a. Safety railings shall be installed in cases where grating panels are not installed or as indicated on the Contract Drawings.

F. Access hatches in sidewalk areas shall comply with the NYCBC.

1.06 QUALITY ASSURANCE

A. Access hatches shall be detailed and fabricated based on calculations prepared by the manufacturer and sealed by a NYS Registered Professional Engineer, indicating that the access hatch is capable of withstanding loads to meet the specified types of access hatches.

B. The Contractor shall require that the manufacturer of the hatches furnish the fall through protection and be responsible for the integration and compatibility of all equipment components provided under this Section.

C. Quality Assurance (QA) Inspections

1. QA inspections may be made by NYC DEP Bureau of Engineering Design and Construction, Quality Assurance Section or its representative at the manufacturer’s facility.

2. QA Inspections shall be in accordance with Section 01 43 10 – Quality Assurance Inspection.

3. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication, so that the QA inspection may be made.
4. QA inspections may include, but no limited to the following activities:
    a. Obtain representative material samples
    b. Obtain copies of certified materials test reports, both chemical and physical, and test report for susceptibility to intergranular corrosion of the stainless steel material, as applicable.
    c. Perform visual inspection of welding, as per AWS D1.2.
    d. Perform visual and dimensional inspection welding of completed work.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer.

B. Shop Drawings shall be signed and sealed by a NYS Registered Professional Engineer. At minimum each detailed drawing and calculation packet shall be signed and sealed.

C. Shop Drawings shall include the following:

1. General layout drawings showing overall frame dimensions, opening at the base of the frame, clear opening size, thickness of the frame and the overall height of the frame, profiles, accessories, location adjacent construction interference and all dimensions and details.
    a. Accessories include drain location, fall through grating details with clearances, and safety barrier chain locations.
2. A list of material manufacturer(s) with the products they manufacture or fabricated, including but not limited to mill test reports.
3. All materials used during the access hatch manufacturing shall be identified by thickness, size, and grade to assure that the appropriate materials are used specific to the hatch design being manufactured.
4. Copies of Specifications, installation instructions, and general recommendations for each access hatch supplied. Manufacturer's data substantiating that all materials comply with the requirements of this Specification.
5. Design calculations and manufacturer's Engineering/product data including prototype test results, design details.
6. Certifications, structural calculations, detailed drawings, plans, elevations, and details of sections and connections
7. Calculations verifying compliance with the performance criteria.
8. Shop drawings shall indicate jointing and anchoring details.

9. Welding procedure specifications and welder and welder operator Certifications shall be as per AWS D1.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Access hatches shall be handled in such a manner that they are transported, unloaded and stored without being over-stressed, deformed or otherwise damages.

B. Shall be transported, handled and stored as per the manufacturer's instruction and recommendations.

1. The access hatches and components shall be stored and covered in a dry, protected, and clean location off the ground.

2. All unfinished surfaces are to be protected from exposure and damage.

C. Coatings shall be applied in the shop; the units are to be delivered ready for installation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall provide a manufacturer's warranty. The manufacturer's warranty shall warrant that access hatches will be free of defects in material and workmanship for a period of ten (10) years from the date of installation. Under the terms of this warranty, should a part fail to function in normal use within this period, the manufacturer shall furnish a new part at no charge.

B. The Contractor shall provide a ten (10)-year warranty from the manufacturer of the fall protection grating system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Access hatches shall be manufactured by:

1. The Bilco Company, New Haven, CT;

2. Acudor Products, Inc. brand, manufactured by USF Fabrication, Hiaheah, FL;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Aluminum

1. Shapes and plates shall be 6061-T6 aluminum alloy with mill finishes and shall be fabricated into finished products with welded or bolted connections as detailed in the Contract Drawings or approved Shop Drawings.

2. Extruded shapes shall meet the requirements of ASTM B221 and B308.

3. ASTM B209 and B632 / B632M, alloys 5052 or 5086.

4. The covers and frame of all hatches shall have a clear anodized shop finish.

B. Stainless Steel

1. Stainless steel shapes and plates shall be Type 316 for bolted construction and Type 316L for welded construction as detailed on the Contract Drawings or approved Shop Drawings and conforming to Section 05 06 00.01 – Schedules for Stainless Steel Work.

2. Shapes shall meet the requirements of ASTM A276.

3. Plates shall meet the requirements of ASTM A480 and A666.

4. Type 316L stainless steel shall meet the requirements of ASTM A240, UNS S31603.

C. Access hatch

1. Personnel access hatches shall be a minimum size of four (4) feet by four (4) feet and be double leaf. Non-personnel access hatches for openings less than four (4) feet long shall be single leaf.

2. Hatch leaf shall be manufactured of minimum ¼ inch thick aluminum or stainless steel diamond-pattern plate designed to withstand a live load as indicated on the Contract Drawings for the adjacent floor or deck area.

D. Frame

1. Channel or tee type frame shall be aluminum with an anchor flange around the perimeter and with a 1-1/2 inch drainage coupling where required.

E. Hinges

1. Hinges shall be heavy duty forged Type 316 stainless steel hinges, having a minimum ¼ inch diameter Type 316 stainless steel pin.

2. Hinges shall be specifically designed for horizontal installation and shall be through bolted to the covers with tamperproof Type 316 stainless steel bolts and locknuts.

F. Drain Coupling

1. Provide a 1-1/2 inch drain coupling located in the right front corner of the channel frame or located as indicated on the Contract Drawings.

G. Lifting Mechanism

1. Manufacturer shall provide the required number and size of compression spring operators, enclosed in telescopic tubes, to provide smooth, easy and controlled cover operation throughout the entire arc of opening and to act as s check in retarding downward motion of the cover when closing. The upper tube shall be outer tube to prevent accumulation of moisture, grit and

debris inside the lower tube assembly. The lower tube shall interlock with a flange support shoe fastened to a formed ¼ inch gusset support plate.

2. Springs shall be sufficient to provide the appropriate amount of lift for each door. Spring shall also be designed to counterbalance the specific cover weight throughout arc and to resist downward force when closing.

3. Compression spring tubes shall be an anti-corrosive composite.

H. Hold-open Arms

1. A Type 316 stainless steel hold open arm shall be provided to lock the cover in the fully open ninety (90) degree position. A release handle shall be provided to allow the grating panel to be closed.

I. Hardware

1. Hatches shall be equipped with recessed padlock hasps. All hardware, including but not limited to mounting brackets, heavy forge hinges, torsion rod, hold open arm with release handle, snap lock, padlock hasp and fasteners shall be Type 316 stainless steel.

2. Locks shall be included as part of the hatch.

3. The locations of hinges and hold-open arm with release handle shall be as shown on the Contract Drawings and approved Shop Drawings.

J. Fall Through Protection

1. Grating panels shall be provided as shown on the Contract Drawings.

a. Grating panel(s) shall be manufactured of fiberglass reinforced plastic (FRP) or aluminum.

1) FRP grating panels shall comply with the following:

a) UV and corrosion resistant construction

b) FRP panels shall be molded in one piece or fabricated of 6061-T6 aluminum grating, with load bearing bars in both directions to allow for use without continuous side support.

c) Grating shall be permanently installed and designed to support a 300 PSF live load.

d) Aluminum grating panels shall be powder coated with high visibility safety yellow finish.

b. Grating panels shall have a provision for locking to prevent unauthorized opening.

c. Hardware and hold-open devices shall be Type 316 stainless steel.

d. Lift assistance shall be provided for ease when opening the grating panel.

e. The grate openings shall be two (2)-inches x four (4)-inches on center.

f. Grating panels shall lock in the fully open position.

g. Grating panels shall open in the same orientation as the hatch doors.

2. Removable safety barrier chains and latches shall be provided.

a. Chain shall be Type 316 stainless steel.

b. Safety chains shall be capable of withstanding one thousand (1,000) pounds of working load and five thousand (5,000) pounds of breaking load.

c. Safety chains shall be removable at both open ends with a maximum three (3)-inch sag when the hatch is open.

3. When grating panels are not applicable or feasible, a Safety Railing System shall be built into the access hatch, such as pop-up or fold up or built into the leafs. Any other options shall be in the Contract Documents and specified herein.

a. Safety railing system shall be fabricated of 1.25-inch diameter (1.6-inch O.D.) schedule 40 Type 6061 T-6 aluminum or Type 316 stainless steel. Safety railing system shall be manufactured of the same material as the access hatch.

b. Safety railings shall extend to forty-two (42) inches in height per OSHA 1910.23;

c. Safety railings shall be retractable and fully contained inside the cover leaf(s) for easy access and storage.

d. Safety railings shall be fitted with ½ inch diameter safety pins to lock the system in either the open or closed position. Safety pins shall be permanently attached to the hatch.

COMPONENTS	HATCH LEAF MATERIAL	
	STAINLESS STEEL	ALUMINUM
Forged Hinges & Hardware	316 Stainless Steel	316 Stainless Steel
Lift Assist Spring Operators	Stainless steel spring enclosed in Type 316 SS housing, ASTM A313.	Spring enclosed in ¾" 316 stainless steel tube
Hold Open Arm	Automatic with release handle Minimum 2 per leaf – one at each end	
Drainage Channel	Minimum cross-sectional area of 7.5 square inches to allow for adequate water drainage	

Diamond plate cover & frame	Minimum ¼ inch thick mill finish	Minimum ¼ inch thick with clear anodized coating
Frame Finish (dissimilar materials)	None	Factory applied bituminous/coating to bond breaker aluminum to concrete
Lock	Recessed padlock hasps. Snap lock with removable handle	
Covers	Min ¼ inch thick mill finish that has been bead blasted to clean the door	Min ¼ inch thick aluminum diamond pattern with anodized coating.
Frame finish	none	Factory applied bituminous/coating

K.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Finishes

1. Aluminum sidewalk access hatches shall be coated with an anodized finish in accordance with the requirements of AAMA 611 Class 2, with a minimum dry film thickness of 0.7 mils, or as specified or indicated on the Contract Drawings.

2. When indicated in the Contract Documents, aluminum access hatches shall be galvanized in accordance with Section 05 05 13.01 – Galvanizing with a No. 4 finish or as detailed in the Contract Drawings or specified herein.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. The access hatch manufacturer shall have and perform quality control operations based on a written quality control program that includes the following:

1. Review and rejection of incoming materials based on certified mill test reports and visual inspections.

2. Frequency of inspection and inspection requirements for cut or cut and bent assemblies and part for hatch construction, assembly welding and completed hatch assemblies.

3. All quality control inspection reports shall be dated and maintained by the hatch manufacturer for a minimum period of seven (7) years.

4. All prototype test records for custom hatches and all production test records shall be dated and maintained by the hatch manufacturer for a minimum period of seven (7) years.

5. All prototype test records for the manufacturer's standard access hatch designs shall be permanently archived.

6. When requested by DEP at the time of request for quotation the written quality control program and the quality control inspection reports during the period of DEP's access hatch, manufacturing shall be provided.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Number, sizes and location of all access hatches shall be provided as shown on the Contract Drawings and approved Shop Drawings.

B. Install the access hatches in accordance with manufacturer's instructions and approved submittals.

1. Test units for proper function and adjust until proper operation is achieved.

2. Repair finishes damaged during installation.

3. Restore finishes, so no evidence remains of corrective Work.

C. Access hatches and their components shall be adjusted for proper alignment and operation.

D. Protective coatings shall be provided for the exterior protection of aluminum frames that are to be cast in fresh concrete to prevent corrosion.

E. Immediately after installation, the Contractor shall clean all the access hatches using products and procedures that are not detrimental to the finishes and as recommended by the manufacturer.

3.03 FIELD TESTING / QUALITY CONTROL

A. All stainless steel materials shall be checked for compliance with tests for susceptibility to intergranular corrosion. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for these tests shall be submitted to the Engineer for approval prior to the start of work. If the certified mill report indicates that such tests have been satisfactorily performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

B. Tolerances

1. Maximum tolerance allowances shall be as outlined in ASTM C 1802, unless indicated on the Contract Documents or by the Engineer.

C. Inspection and Field Verification

1. The Contractor shall verify that the area to receive the access hatch is properly prepared and set to the proper elevation.
2. Contract shall meet the requirements of the manufacturer's installation recommendations and approved Shop Drawings.

D. Repairs

1. Repairs are to be performed as per manufacturer's recommendations and meet the requirements of ASTM C 1802.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 06 05 01 – UNTREATED TIMBER AND LUMBER
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install all untreated timber and lumber as shown on the Contract Drawings, specified in the Contract or required for the Work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	4

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 13.01 - Galvanizing

1.04 REFERENCES

A. Reference Standards:

1. ASTM D245 - Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

1.05 DESCRIPTION

A. Sustainability requirements:

1. Certified Sustainably Harvested Lumber: Dimensional lumber derived from a Well Managed Forest as certified by one of the following certification organizations:

a. Scientific Certification Systems (SCS)

b. Forest Stewardship Council (FSC)

c. Institute for Sustainable Forestry (ISF)

d. Or other verifiable high-quality forestry management program

1.06 QUALITY ASSURANCE

A. All natural wood lumber used in the Work shall be verified as obtained from a certified sustainable natural wood lumber source using sustainable forest management practices.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Copies of manufacturer's certificates showing compliance with the specified material requirements.

2. Third party certification for each type of timber and lumber shall be submitted to the Engineer prior to purchase. Certification shall include, at a minimum, documentation of the following:

a. The producer has been subject to a formal field-level assessment.

b. The producer has met minimum environmental, silvicultural, and social criteria established by the certifying agency.

c. The producer has agreed to periodic or random audits of forestry operations.

d. The producer has agreed to a specific timeline for continual improvement of forest management operations.

e. The producer has agreed to provide chain-of-custody documentation at the request of Contractor and/or Engineer.

f. Copies of a certificate, signed by producer, certifying that the softwood lumber producer complies with quality grades and other requirements as specified. The certificate shall be submitted in a form recommended by applicable standards, written by the certifying organization.

3. Certification shall be submitted for timber and lumber designated to be fire retardant treated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Storage of Materials

1. Materials shall be stored on raised platforms, indoors at the Site. If outdoor storage has to be incorporated, the material shall be set on raised platforms and covered with suitable weatherproof protective coverings, such as tarpaulins or heavy polyethylene film. Covers shall be battened down to prevent the covers from blowing off.

B. Handling of Materials

1. All timber and lumber shall be carefully handled to avoid splitting or damage to the surface and edges.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Timber and Lumber

1. All timber and lumber used for sheeting, shoring, bracing, decking and for other purposes shall be sound and free from any defect that may impair its strength and shall be graded in accordance with ASTM D245. Timber and lumber shall have sufficient strength, be of suitable quality for the purposes intended, and be of sizes shown on the Contract Drawings, specified in the Contract or required for the Work.

2. Timber and lumber for shoring and bracing shall be new, merchantable pine, Douglas fir, or spruce, unless otherwise shown on the Contract Drawings or specified in the Contract, and shall be squared to the required dimensions throughout its entire length.

3. Timber and lumber for decking and supports shall be suitable, hard, yellow pine.

4. No second-hand timber or lumber shall be used where strength and appearance are important considerations, and in all cases the Engineer shall determine if such material is suitable for the proposed use.

B. Fasteners

1. Timber and lumber shall be fastened with nails, spikes, bolts, rods, plates, washers and all other hardware shall be of the type, size, and spacing to meet the conditions encountered.

2. Fasteners exposed to the weather shall be hot dip galvanized in accordance with Section 05 05 13.01 - Galvanizing, unless other materials are indicated on the Contract Drawings or called for in the Contract.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Timber and lumber shall be firmly fastened with approved nails, spikes, bolts, rods, plates, and all other hardware of the proper sizes and lengths required to obtain the necessary strength and stability.

B. All sheeting and bracing shall be installed by skilled mechanics, keyed tight by wedges where necessary and arranged to permit ready withdrawal without endangering the adjacent soil. Sheeting shall not be cracked or split in driving.

C. Sheeting shall be tongued and grooved where necessary to obtain required results.

D. The sustaining members in bracing systems shall be designed and constructed to fully support, without undue deflection, all loads imposed.

E. Wedges, steel plates and other devices approved by the Engineer shall be used in effecting the necessary reactions. Special care shall be taken to assure the stability of foundations supporting vertical posts.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Rough carpentry as specified herein shall include, but not be limited to, wood centers, furring, grounds, blocking, temporary protection of all kinds, and all accessories and appurtenances.

B. Rough carpentry shall be provided where shown on the Contract Drawings, specified herein and as required otherwise for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Abbreviations and Acronyms

1. AWPA – American Wood Protection Association
2. AWC – The American Wood Council

B. Reference Standards:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
2. AWPA T1 - Use Category System: Processing and Treatment Standard
3. AWPA U1 - Use Category System: User Specification for Treated Wood
4. AWC - National Design Specification for Wood Construction

1.05 DESCRIPTION

A. Sustainability requirements:

1. Certified Sustainably Harvested Lumber: Dimensional lumber derived from a Well Managed Forest as certified by one of the following certification organizations:
   a. Scientific Certification Systems (SCS)
   b. Forest Stewardship Council (FSC)
   c. Institute for Sustainable Forestry (ISF)
   d. Or other verifiable high-quality forestry management program
2. Salvaged Lumber: Lumber from deconstruction or demolition of existing buildings or structures. Unless otherwise noted, salvaged lumber shall be delivered clean, de-nailed, and free of paint and finish materials and other contamination. Provide documentation certifying products are from salvaged lumber sources.

1.06 QUALITY ASSURANCE

A. Contractor shall provide products from acceptable manufacturers which have been used satisfactorily in similar service for at least three years.

B. Mark each piece of lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings, catalog cuts and reference materials for approval of the Engineer. Submittals shall include, but not be limited to:

1. Rough Wood Carpentry: The following shall be submitted:
   a. Copies of the chemical treatment manufacturer’s instructions for proper use of each type of treated material.
   b. For water-borne preservatives, the submittal shall include the statement that moisture content of treated materials was reduced to

a maximum of nineteen (19) percent prior to shipment to Project Site.

c. Submittal shall indicate compliance with specified standards and other specified requirements for materials and workmanship.

2. Sustainability:

a. Recycled Content:

1) Engineered Wood Products:

a) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

b) Indicate relative dollar value of recycled content product to total dollar value of product included in Project.

c) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.

d) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2) Salvaged Lumber: Provide documentation certifying products are from salvaged lumber sources.

b. Local/Regional Materials:

1) Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the Project Site.

2) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the Project Site.

3) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

4) Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Rough carpentry materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall, however, be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored with manufacturers' labels and seals intact.

2. Lumber shall be stored indoors at the Site on raised platforms. If outdoor storage is temporarily incorporated, material shall be set on raised platforms and covered with suitable weatherproof protective coverings, such as tarpaulins or heavy polyethylene film. Covers shall be battened down with sufficient weights, ties or anchors to prevent blow-offs.

3. Damage to materials shall be prevented during storage primarily by minimizing the amount of time they are stored at the site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled carefully in order to avoid damage or breakage.

2. Materials shall be handled in a manner which prevents inclusion of foreign materials.

3. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the site and shall not be incorporated into the Work.

4. Do not open packages or containers until all preparatory Work is complete and installation will begin immediately. Do not allow materials to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. General: All natural wood lumber used in the Work shall be verified as obtained from a certified sustainable natural wood lumber source using sustainable forest management practices.

B. Rough Carpentry: Lumber for rough carpentry such as nailers, grounds, blocking and framing shall be of Sustainably Managed Construction Grade, thoroughly seasoned dry No. 1 white fir, ponderosa pine, spruce or hem-fir.

C. Code Conformance: Materials shall conform to the requirements of the National Design Specification for Wood Construction as recommended by the American Wood Council, unless otherwise indicated.

D. Plywood Standards: Plywood shall conform to the requirements of the American Plywood Association.

E. Grading: Each panel of plywood shall be identified with the appropriate DFPA grade mark of the American Plywood Association.

F. Exterior Plywood Uses: Exterior type plywood shall be installed where plywood is used for roof sheathing or decking, or in areas where it may be exposed to moisture.

G. Temporary Protection: Exterior type southern yellow pine plywood, APA Grade C, plugged fir shall be used for temporary protection.

H. Accessories

1. Anchors, connectors, and fastenings, not indicated or specified otherwise, shall be provided and installed and shall be of the type, size and spacing necessary to suit the conditions encountered and as recommended by National Forest Products Association. Sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials shall be as recommended by the product manufacturer, unless indicated or specified otherwise.

   a. Steel rough hardware exposed to the weather shall be zinc-electroplated unless indicated otherwise. Zinc-electroplated steel bolts, nuts, washers, hangers, and straps, and all other rough hardware embedded in, or in contact with exterior walls or slabs, and located in humid areas, shall be provided and installed, except as indicated otherwise.

   b. Rough hardware shall be formed and punched before coating. Common steel wire nails, bright finish, shall be used, unless specified otherwise.

   c. Bolt heads and nuts bearing on wood shall be provided with standard steel washers.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive rough carpentry which is to be incorporated into the finished Work are properly prepared and completed to final elevations.

3.02 INSTALLATION

A. General: Rough carpentry shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings.

B. Erection: All carpentry shall be correctly laid out. All items of woodwork, hardware, and any other work in connection with carpentry shall be carefully fit and erected, accurately located, and shall be plumb, level, and properly aligned, and rigidly secured in place.

C. Blocking: Blocking shall be furnished and installed where required for the attachment of copings, roof ventilators, ducts and other sheet metal work. Wood grounds for other Work shall be provided and installed as shown and required.

D. Securing Finished Work: Wood blocks, strips, plugs and similar items shall be provided and installed as required to secure finished work to concrete and masonry.

E. Centers: Centers shall be provided, where required, for brick and other masonry at the exterior and interior openings.

F. Protection of other Work: Jambs of finished door frames and finished masonry openings shall be protected to a height of six (6) feet above the floor. Protection shall be erected in a manner to facilitate cleaning, painting and similar Work without damage to finished Work.

G. Preservative Coating: All field-cut edges and surfaces of treated lumber shall be liberally coated with a concentrated solution of preservative.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. System components which are dislodged, damaged, expanded, broken, penetrated or crushed by subsequent installation operations or by detrimental weather shall be immediately replaced with undamaged material in compliance with the Sections and properly protected as specified.

B. Protection

1. All components of the Work shall be protected from detrimental weather and damage until construction operations are completed.
2. Work which cannot be covered with complete construction systems before the onset of weather detrimental to the work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.
3. Rough carpentry shall be protected from all damage and abuse until Final Acceptance by the City.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the requirements for roofing insulation systems under EPDM roofing.

B. The Work also includes all miscellaneous materials and accessories and a Job Conditions Report from the installer of the composite roofing insulation containing information specified. Contractor shall also include the presence of a full-time on-Site composite roofing manufacturer's Technical Representative and provide a ten (10)-year composite roofing insulation performance warranty. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and field test roofing insulation Work.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The roofing insulation system described herein must come from the same manufacturer as the Elastomeric Membrane Roofing described in Section 07 53 00.

E. The following index of this Section is presented for convenience:

F.

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Special Warranty Provisions / Guarantee Periods	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	11
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	13

3.05 Adjusting / Protection / Cleanup.....13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 07 53 00 - Elastomeric Membrane Roofing

1.04 REFERENCES

A. NYCBC - New York City Building Code

B. NYCECCC - New York City Energy Conservation Code

C. ASTM C150 - Standard Specification for Portland cement

D. ASTM C177 - Steady-State Heat Flux Measurement and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus, Test Method for

E. ASTM C203 - Breaking Load and Flexural Properties of Block-Type Thermal Insulation, Test Method for

F. ASTM C272 - Water Absorption of Core Materials for Structural Sandwich Construction, Test Method for

G. ASTM C303 - Dimensions and Density of Preformed Block-Type Thermal Insulation, Test Method for

H. ASTM C495 - Compressive Strength of Lightweight Insulating Concrete, Test Method for

I. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

J. ASTM C550 - Measuring Trueness and Squareness of Rigid Block Thermal Insulation, Test Method for

K. ASTM C578 - Rigid Cellular Polystyrene Thermal Insulation, Specification for

L. ASTM C796 - Foaming Agents for Use in Producing Cellular Concrete

Using Preformed Foam, Test Method for

M. ASTM C869 - Foaming Agents Used in Making Preformed Foam for Cellular Concrete, Specification for

N. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer

O. ASTM D1621 - Compressive Properties of Rigid Cellular Plastics, Test Method for

P. ASTM D1623 - Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics, Test Method for

Q. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products

R. ASTM E84 - Surface Burning Characteristics of Building Materials, Test Method for

S. ASTM E96 - Water Vapor Transmission of Materials, Test Method for

T. FM - Factory Mutual Incorporated, Approval Guide

U. UL - Building Materials Directory Fire Resistance Directory

1.05 DESCRIPTION

A. System Design Requirements

1. Roofing insulation Work shall withstand the uplift forces of wind, as defined by the roofing guarantee. Refer to Section 07 53 00 - Elastomeric Membrane Roofing.

2. Failures of the roofing insulation Work in bond or anchorage to the substrate, or within the insulation, will be considered failures of materials or workmanship under the insulation performance warranty.

B. Sustainable Design Requirements

1. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2. Insulation shall be produced using a blowing agent with zero ozone-depleting potential. HCFC-142b or HCFC-141b shall not be used.

3. Recycled Content of Roof Insulation Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than fifteen (15) percent.

C. Substitutions

1. Manufacturer of the primary roofing systems shall be manufacturers who find the generic types of insulation specified herein as acceptable and

bondable if installed according to the roofing manufacturer's standards for complete product and performance responsibility.

2. The thickness of the composite insulation system, the maximum step between layers of expanded polystyrene rigid board insulation, and the minimum slope-to-drain shall not vary from what is shown, specified, and approved.

1.06 QUALITY ASSURANCE

A. Composite Roofing Insulation Installer Qualifications:

1. Subcontract roofing insulation Work to an installer approved in writing, who has qualified for appointment and has been trained by the manufacturer of the composite roofing insulation system.

2. Engage a single installer skilled, trained, and with successful experience in the installation of the type of composite roofing insulation specified, and equipped to perform workmanship in accordance with both the requirements of the manufacturer of the composite roofing insulation and of the single-ply roofing manufacturer so that there will be unequivocal responsibility for the performance of the roofing insulation Work.

3. Submit proofing of acceptability of installer by manufacturer to the Engineer.

B. Performance Criteria:

1. The thicknesses shown are for the thermal conductivity, k-value at seventy-five (75) degrees Fahrenheit specified for each material.

2. Comply with Factory Mutual Technical Advisory Bulletin 1-29 for recommendations concerning requirements for 1-90 securement.

3. Provide composite roofing insulation system recommended by the manufacturer for use on non-vented substrates.

C. Erection Tolerances: Provide the following for composite roofing insulation:

1. Provide minimum of 1/8-inch leveling slurry coat of insulating concrete over the top of cast-in-place concrete roofing decks.

2. Finished system shall not pond water and shall provide a uniformly sloped surface to low point of roof drains. If at any time up to the time of Final Acceptance the roofing shows signs of ponding water, the composite roofing insulation system shall be repaired to provide uniform slope to drain.

D. Requirements of Regulatory Agencies: Comply with fire-resistance ratings as shown, and as required by governing authorities and the New York City Building Code and comply with the following roofing insulation requirements:

1. Materials and equipment submitted for DEP’s approval by the Contractor shall have met, at the time of their submittal, the certification and material

acceptance requirements of the NYC Department of Buildings, unless otherwise required by the Authority Having Jurisdiction over the Work.

2. All material provided under this Section shall comply with the Detailed Specifications.

3. Comply with all applicable requirements of governing authorities and codes for all Work.

4. U.L. requirements for Roofing Deck Constructions which are rated "UL Construction No. 1".

5. Factory Mutual requirements for "Class 1" construction, for fire hazard and 1-90 wind resistance.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to:

1. Samples: Submit for approval the following:

a. Each fastener to be used in the Work.

b. Twelve (12)-inch by twelve (12)-inch sample of specified rigid board type insulation and composite insulation system. Twelve (12)-inch by twelve (12)-inch sample of specified rigid board-type insulation and composite insulation system.

2. Shop Drawings: Submit for approval the following:

a. Manufacturer's specifications and installation instructions for type of insulation required. Include data substantiating that the materials comply with specified requirements.

b. Weights of all equipment to be used on roofing.

c. Field verified locations of all roof penetrations, drain locations, and deck deflections.

d. Complete layout of all roofing insulation showing sizes, placement and number of courses and methods of fastening.

e. All required roofing insulation details approved by the roofing insulation manufacturer and the manufacturer of the respective roofing systems.

f. Laboratory test results for Thermal Resistance Values based on ASTM C177 or ASTM C518 for actual composite roofing insulation system shown and specified.

3. Certifications: Submit Job Conditions Report as specified and, in addition, include a notarized statement from the full-time on-site Technical Representative and installer that the composite roofing insulation system was installed according to manufacturer's written recommendations.

4. Sustainable Design Submittals:
    a. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:
        1) Name of Product and Manufacturer.
        2) Cost of product: Material cost only (excluding labor and equipment).
        3) The percentage (by weight) of post-consumer and pre-consumer recycled content for the submitted product.
    b. VOC Reporting Form:
        1) For adhesives used onsite and within the building's weatherproofing system provide the VOC content in grams/Liter (g/L) less water and exempt compounds.
5. Sustainable Design:
    a. Recycled Content: Submit percentage of recycled content for each material or product. No product shall contain CFC, HCFC (hydro-chlorofluorocarbon) or any Resin base chemical.
    b. Regional Materials: Submit location of product manufacturer and distance from manufacturing location to the Project Site.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
1. Do not deliver roofing insulation materials to the Project Site before time of installation.
2. Deliver materials in manufacturer's original, undamaged packages or acceptable bulk containers.
3. Materials shall be manufactured and delivered from manufacturing locations that are closest to the Project Site to reduce transportation costs and emissions.

B. Storage of Materials:
1. Do not allow roofing insulation materials to become wet or soiled, or covered with ice or snow.
2. Store packaged materials to protect them from the element and physical damage.

C. Handling of Materials:
1. Comply with manufacturer's recommendations for handling, storage, and protection.
2. Do not use cement which shows indication of moisture damage, caking, or other signs of deterioration.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 SPECIAL WARRANTY PROVISIONS / GUARANTEE PERIODS

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

B.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roofing insulation systems shall be as manufactured by:

1. Firestone; Polyiso Insulation
2. Sika sarnafil; Styrofoam insulation
3. Or an approved equal.

2.02 MATERIALS / EQUIPMENT

A. Very High Load bearing Extruded Polystyrene Roofing Insulation: Provide the following above all liquid-applied membrane waterproofing inverted roofing beneath cast-in-place concrete rooftop wearing slabs:

1. Rigid, closed-cell, thermally stabilized, very high load bearing extruded foam board insulation consisting of extruded polystyrene modified resin complying with ASTM C578, Type V.
2. Physical Properties: Provide the following:
   a. Provide roofing insulation to meet R-value required by IECC.
   b. Thermal Conductivity (k), ASTM C177 and ASTM C518: 0.20 Btu/in./hr./sf/EF.
   c. Thermal Resistance per inch, ASTM C177 and ASTM C518: 5.0 deg F x h x sq. ft. /Btu x in. at 75 deg F.
   d. Compressive Strength (psi at 5% deformation) ASTM D1621: 100 psi minimum.
   e. Flexural Strength, ASTM C203: 100 psi minimum.
   f. Coefficient of Thermal Expansion, ASTM D696: 3.5×10^{-5} inches/inches x deg F.
   g. Water Vapor Absorption, ASTM C272: 0.3% by volume maximum.
   h. Water Vapor Permeance, ASTM E96: 0.8 perms/inch maximum.
   i. Flame Spread, ASTM E84: 5.

j. Smoke Developed, ASTM E84: 165 maximum.

3. Thickness: Match the thicknesses of the insulation layers of the previous roofs.

4. Width: twenty-four (24)-inches.

5. Length: ninety-six (96)-inches.

B. Composite Roofing Insulation: Provide the following beneath all single-ply membrane roofing system:

1. Expanded Polystyrene Rigid Board: Provide the following board as a system component of the composite roofing insulation system for use beneath all single-ply roofing:

a. Provide roofing insulation to meet R-value required by IECC.

b. Rigid-expanded polystyrene modified resin bead board with bead fusion of eighty (80) percent minimum with no visible voids.

c. Molded blocks air dried for minimum of six (6) weeks with less than 0.5 percent residual pentane prior to fabrication.

d. Size: twenty-four (24)-inches by forty-eight (48)-inches with pattern of thirty (30) holes and thirty (30) slots per board.

e. Dimension Tolerances, ASTM C 550:

1) Length: ±1/16 inch.

2) Width: ±1/16 inch.

3) Thickness: ±1/16 inch.

4) Squareness: ±1/16 inch.

5) Flatness: ±1/32 inch.

f. Physical Properties:

1) Density, ASTM C578: Type I, 1 lbs. /cu. ft.

2) Thermal Resistance, (R at 75°F), ASTM C177 and ASTM C518: R=3.85 s.f./°F/hr./BTU.

3) Thermal Conductivity (k at 40°F), ASTM C177 and ASTM C518: U-0.25 BTU/in. hr./s.f./°F.

4) Coefficient of Thermal Expansion, ASTM D696: 3.5 x 10^{-5} in/in./°F.

5) Compressive Strength (10% deflection), ASTM D1621: 13-17 psi.

6) Flexural Strength, ASTM C203: 28-35 psi.

7) Tensile Strength, ASTM C1623: 16-20 psi.

8) Water Vapor Transmission, ASTM E96: 1.2-2.2 perms.

9) Water Vapor Adsorption, ASTM C272: Less than two (2) percent

10) Flame Spread, ASTM E84: 5.

11) Smoke Developed, ASTM E84: 40-85.

2. Thicknesses: Stair-stepped arrangement with thicknesses of boards comprising all but top two inches and bottom 1/8 inch of composite roofing insulation system and of total system thicknesses as shown and specified.

3. Insulating Concrete: Provide the following:

a. Portland Cement: ASTM C150, Type I, II or III.

b. Calcium Chloride: Not permitted.

c. Pre-generated Foam: Concentrated liquid with clear identification as to manufacturer and type of material carrying FM and UL approved labels complying with ASTM C796 and ASTM C869.

d. Water: Potable, clean, and free from deleterious amounts of acid, alkali and organic materials.

e. Physical Properties: Provide the following physical properties for the insulating concrete design mix:

1) Minimum Compressive Strength, ASTM C495: 200 psi.

2) Density at Placement: 38-48 pcf.

3) Oven Dry Density: 30-36 pcf.

4. Reinforcing Mesh: 2160-2-1619 galvanized mesh as recommended by the manufacturer of the composite roofing insulation.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall examine the substrate and the conditions under which the roofing insulation Work is to be performed, and notify Engineer in writing of any unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

2. Environmental Requirements:

   a. Do not install insulation when weather conditions are such that the deck is not completely dry, or where there is no assurance that the insulation can be completely protected from the weather by the end of the day.

   b. For applications of composite roofing insulation system when the temperature is expected to fall below forty (40) degrees Fahrenheit, submit written installation recommendations of the composite insulation system manufacturer confirming acceptability of the conditions encountered. Contractor shall verify that composite roofing insulation systems installed under such adverse weather conditions meet all material and performance requirements specified. Record actual conditions of installation, including intervals between system component placement, weather and temperature conditions, temporary uses of roofing (if any), and other pertinent installation factors and submit notarized information signed by manufacturer's full-time on-Site technical representative to Engineer.

   c. Hot water is not available at the Project Site and shall be supplied by composite roofing insulation installer as required by installation conditions.

   d. Potable water is not available at the Project Site and shall be provided by composite roofing insulation installer.

B. Preparation

1. Pre-Roofing Conference: Provide both a representative of the composite roofing insulation system manufacturer and the foreman of the installer who will actually work on this job at the pre-roofing conference specified in Section 07 53 00 – Elastomeric Membrane Roofing.

2. Verify that fire-resistant cement board insulation underlayment is in place on sloping metal decks and that channel-shaped attachment angles and adjustable radiused hat sections are properly installed over all areas to receive sheet metal roofing Work.

3. Do not overload the building structure with the weight of stored materials or use of equipment.

4. Sequencing:

   a. Proceed with and complete the Work only when materials, equipment, and tradesmen required for the installation of the roofing membrane and sheet metal roofing over the insulation are at the Site and are ready to follow with this Work immediately (same day) behind the insulation Work.

b. Do not install any more board-type insulation each day than can be covered with the complete sheet metal roofing system by the end of that working day.

c. Follow composite roofing insulation manufacturer written requirements for installation timing sequence for Work. Do not place more leveling slurry coat than can be completely covered with insulation within thirty (30) minutes nor more expanded polystyrene insulation than can be covered with insulating concrete within four (4) hours of placing insulation.

3.02 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to the Project conditions, consult the manufacturer's full-time on-site Technical Representative for specific recommendations before proceeding with the Work. All such discussions shall be recorded in writing in Job Conditions Report and shall be incorporated into the Work only when acceptable to Engineer.

2. Coordinate heights of wood blocking to provide flush transition between roofing insulation Work and perimeter wood blocking.

3. Extend insulations full thickness as shown over entire surface of the roofs.

4. Cut and fit board-type insulation tightly around obstructions, and fill voids with insulation. Keep back 1/4 inch for all vertical flashings.

B. Laying Board-Type Insulation Units for Sheet Metal Roofing System:

1. Apply four courses of rigid board insulation over entire surface of roofs receiving sheet metal roofing between continuous adjustable radiused hat sections.

2. Mechanically fasten in accordance with the requirements of the applicable fire and insurance ratings and primary roofing manufacturer's recommendations, and apply in accordance with the recommendations of the manufacturer of the insulation, mechanical fastener and completed roofing system manufacturer.

3. Install insulation board with the long joints between boards perpendicular with incline of deck. Cut roofing insulation and taper edges of boards where curvature of deck requires, to fit snugly beneath oriented strand board sheet metal roofing substrate Work. Remove ridges between insulation boards and provide a smooth transition between boards following curvature of adjustable radiused hat sections.

C. Laying Composite Roofing Insulation System for Single-Ply Roofing System:

1. Place insulating concrete using approved equipment after sufficient mixing time to provide a consistent, thoroughly uniform consistency that will screed to a smooth surface and achieve the compressive strength specified.
2. Provide insulating concrete leveling slurry to a depth of 1/8-inch above the top of deck.
3. Place expanded polystyrene rigid board insulation into the slurry within thirty (30) minutes of insulating concrete placement with joints staggered in a running bond pattern.
4. Tightly butt all rigid boards together and install in a manner that provides full contact of slurry to board, and with adequate pressure to cause insulating concrete to enter the locking/keying openings of the rigid board.
5. Install rigid boards in a stair-stepped configuration with maximum step down of one (1) inch between boards, over entire plane of roof surface beneath all single-ply roofing. Cut boards as required in order to maintain two (2) inches of insulating concrete cover at insulation step in compliance with the slope-to-drain and high point and low point elevations shown.
6. Within four (4) hours of rigid board placement, place two (2) inches of insulating concrete over rigid boards and screed to a smooth, consistently dense, uniformly sloped plane leading to roof drains at low points. Ensure that all locking/keying openings in rigid board are completely filled with insulating concrete. Provide finish and other system features acceptable to single-ply roofing installer.
7. Include reinforcing mesh as part of the composite roofing insulation system to help control crack formation and distribute forces within the roofing insulation system.
8. Provide high and low point elevations shown.

D. Laying Board-Type Insulation Units for Liquid-Applied Membrane Waterproofing Inverted Roofing:

1. Apply two (2) courses of very high load bearing rigid board insulation over entire surface of roofs.
2. Adhesively adhere boards, staggering joints between courses.
3. Be prepared to follow immediately with cast-in-place concrete sloped-to-drain wearing slab.

3.03 FIELD TESTING / QUALITY CONTROL

A. Retain a minimum of four (4) three (3)-inch by six (6)-inch cylinder material specimens for each day's pour. Protect specimens from damage and temperature extremes and test in accordance with ASTM C495. Submit results of test as part of notarized Job Conditions Report and submit to Engineer.

B. Check cast density hourly at the point of placement. Include reports as part of notarized Job Conditions Report information and submit to Engineer.

1. Final Acceptance will be contingent upon the receipt by the Engineer of a Job Conditions Report certifying conformance of the Work with the requirements of the Section and which includes all information required.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Insulation which has become wet, damaged, or deteriorated shall be promptly removed from the job, even if already installed.

2. Correct all improperly sloped, chipped, cracked, improperly set, ridged or rough areas in the insulation to provide substrate acceptable to roofing manufacturer and Engineer.

B. Protection

1. Do not permit construction period traffic over completed roofing insulation Work, except as required for roofing.

2. Protect insulation Work from exposure to moisture, damage and deterioration, primarily by prompt installation of roofing Work to be placed over the insulation.

3. Do not expose completed Work to prolonged exposure to elements in excess of seven (7) days.

4. Do not use completed roofing insulation as a temporary working surface without protection approved by insulation installer.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 07 32 00 – ROOF TILES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for clay roofing tiles and related roofing system component work including barrel shape clay roofing tiles and manufacturer's complete selection of specialty fabricated clay tile shapes, asphalt-saturated felt underlayment, cold-applied self-adhering rubberized asphalt membrane flashing, and miscellaneous materials, accessories, and fastening systems. Roofing tiles shall conform to the requirements specified herein, and as shown on the Contract Drawings. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and place into satisfactory service all roofing tiles and related system component work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	11
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 07 62 00 - Sheet Metal Flashing and Trim

B. Section 07 71 00 - Roof Specialties

1.04 REFERENCES

A. NYCBC - New York City Building Code

B. BSA - Board of Standards and Appeals

C. ASTM C144 - Aggregate for Masonry Mortar, Standard Specification for

D. ASTM C270 - Mortar for Unit Masonry, Standard Specification for

E. ASTM D312 - Asphalt Used in Roofing, Standard Specification for

F. ASTM D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection, Standard Specification for

G. ASTM D2626 - Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing, Standard Specification for

H. ASTM D4586 - Asphalt Roof Cement, Asbestos-Free, Standard Specification for

I. ASTM E108 - Fire Tests of Roof Coverings, Standard Test Methods for

J. NRCA - National Roofing Contractors Association, the NRCA Roofing and Waterproofing Manual: Section "Steep-slope Roofing"; The NRCA Green Roof Systems Manual.

1.05 DESCRIPTION

A. Scheduling:

1. Do not proceed with the roofing tile work until substrate construction, wood nailing strips, blocking, flashings, and other construction to receive the Work of this Section is completed.

2. Schedule the installation of flashing and trim to coincide with the installation of the tile roofing. Coordinate the work with Sections 07 62 00 – Sheet Metal Flashing and Trim and 07 71 00 – Roof Specialties.

3. Do not proceed with the Work until all material required for the Work is at the Project Site and has been prepared for use.

4. Do not set roofing tiles until other trades have completed Work requiring traffic on, or across, roof surfaces.

B. Weather Limitations: Proceed with the installation of the roofing tiles and related roofing system component work only when existing and forecasted weather

conditions will permit work to be performed according to manufacturers' recommendations and warranty requirements, and when substrate is completely dry.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer skilled, trained, and with successful experience in the installation of clay roofing tile and with specific skill and successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to the Engineer along with the following information on a minimum of three (3) successful projects:

a. Names and telephone numbers of owners, architects, or engineers responsible for projects.

b. Approximate contract cost of the clay roofing tiles.

c. Amount of area installed.

B. Performance Criteria:

1. Maintain the visual design concept shown, and the technical requirements specified, including modules, profiles, alignment of components, and requirements for finish.

2. Comply with installation details of The NRCA Roofing and Waterproofing Manual: Section "The NRCA Steep Roofing Manual" of The National Roofing Contractors Association and the roofing tile manufacturer's written recommendations and details for warrantied construction as shown on Shop Drawings approved by Engineer.

C. Requirements of Regulatory Agencies: Comply with fire-resistance ratings as shown, and as required by governing authorities and the New York City Building Code and comply with the following requirements:

1. Material and Equipment Acceptance Division of the Board of Standards and Appeals (BSA) of New York City Department of Buildings: Where, in order to be incorporated into the Work, a particular item or product system specified by Engineer requires acceptance by the New York City Commissioner of Buildings, the Contractor shall assist the product manufacturer in obtaining such approval, without additional expense to DEP, and in providing DEP with an approved certified copy of the boards resolution giving the MEA number for the item or product system which shall be submitted to Engineer as part of the Shop Drawing approval process. Contractor may submit, in place of products specified by Engineer, products which are "equal" in all ways to the product specified but which have already achieved an MEA number. Such "or approved equal" product submissions shall not change the requirements of these Sections as to

performance, required features or properties, as determined by Engineer, and shall not require additional compensation to Contractor or additional expense to DEP. Final acceptance of "equal" is at the sole determination of Engineer.

2. Comply with all applicable requirements of governing authorities and codes for all Work.

3. In those instances where the Commissioner of Buildings requires a certificate of compliance of the manufacturer or producer certifying that the item or product system was tested and is equivalent to material of the same kind and quality regularly being manufactured by such manufacturer or producer, Contractor shall provide all such certificates to the Commissioner of Buildings without additional expense to DEP.

4. Provide labeled materials and certificates of compliance for materials specified which have been tested and listed by UL for fire test response class and wind resistance test rating and as required by the New York City Building Code. Identify each bundle of roofing tiles with appropriate markings indicating fire and wind resistance test response classification of testing and inspection agency.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to:

1. Samples: Submit for approval the following:

a. Full size units, or sections of units, showing complete selection of specified clay roofing tile manufacturer's standard and custom colors, textures, and an adequate quantity of clay roofing tile to establish the full range of color variation to be approved for the Work by the Engineer.

b. Special shapes needed to avoid field-cutting, close eaves, rakes, hips and ridges, provide tile vents and ridge vents, for final selection by Engineer.

c. Each component of roofing tile fastening system to be used in the Work.

d. Samples will be reviewed by the Engineer for pattern, texture, and color only. Compliance with all other requirements is the responsibility of the Contractor.

2. Shop Drawings: Submit for approval the following:

a. Copies of manufacturer's specifications, standard published application instructions and "spec-data" sheet for clay roofing tiles. Include manufacturer's certification or other data substantiating that the materials and finishes comply with the requirements.

b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.

c. Manufacturer's recommended installation and specification manuals, that once approved, shall become the standard for clay roofing tile installation and details.

d. Completely dimensioned and coordinated roofing tile plans and details of construction and erection showing all field tile, intersections, and specialty roofing tiles as required to avoid cutting tile in the field, provide ventilation, and ensure permanent watertight conditions. Coordinate and show special fastener system as may be required by type of substrate shown on the Contract Drawings.

e. Coordinated Shop Drawings showing the integration of roofing tile manufacturer-required flashing profiles such as drip edges, valley flashing, ridge flashing, and other flashings required to render the Work permanently watertight. Show ridge and soffit ventilation system and recommended flashing coordinated with Sections 07 62 00 – Sheet Metal Flashing and Trim and 07 71 00 – Roof Specialties. Show all flashing details at the scale of 1-1/2 inch to the foot.

B. Contractor's Review: Accompanying approval request, submit to the Engineer a written statement signed by the Contractor, stating that the Drawings and Sections for roofing tile and flashing have been reviewed with an agent of the roofing tile material manufacturer and that he is in agreement that the selected systems are proper, compatible, and that the details shown are not in conflict with the roofing tile manufacturer's roofing and flashing details. Show by copy of transmittal form that a copy of the statement has been transmitted to the manufacturer.

C. Statement of Application: Upon completion of the Work, submit a notarized statement to Engineer signed by Contractor stating that the Work complies with the requirements of these Sections and the installation methods comply with the manufacturer's printed instructions, meets requirements regarding system performance, and were proper and adequate for the condition of installation and use.

D. Warranty: Submit the following:

1. Provide manufacturer's warranty on installed Work, agreeing to pay for repair or replacement of defective roofing tiles.

2. Complete procedures and responsibilities for contacting the manufacturer concerning defective products and maintenance of fifty (50)-year warranty.

E. Maintenance Manuals: Submit the following:

1. Product name and manufacturer.

2. Name, address and telephone number of manufacturer and local distributor.

3. Detailed procedures for routine maintenance and cleaning, including recommended inspection procedures.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver roofing tiles and all other roofing system components and all accessories dry and undamaged, with manufacturer's protective coverings intact, bearing original intact factory labels accurately identifying manufacturers and confirming that products delivered to the Project Site are as approved by the Engineer at time of Sample and Shop Drawing submission.

2. Roofing tiles and other roofing system components that are damaged during delivery, or while being unloaded, shall not be stored on Site. Remove such items from Site and replace with new, undamaged material.

B. Storage of Materials:

1. Store roofing tiles and accessory materials in a dry location and in a manner that will protect packaging from exposure to sun and condensation; with good air circulation around each package and with protection from windblown rain.

2. Roofing Tiles:

a. Stack palletized tiles not more than two pallets high.

b. Stack loose tile on butt end on blocking and straight as possible in level rows not more than two tiles high.

c. Do not store tiles in flat position.

3. Store rolls of underlayment on ends and protect from weather.

4. Store fasteners in original, unopened containers until used.

5. Protection:

a. Store roofing tiles and accessory materials under tarpaulin covers and in an area protected from dirt, damage, weather, and from the construction activities of all Contractors. Do not store them outside or allow items to become wet or soiled in any way while on Site.

b. Do not store in contact with concrete, earth, or other materials that might cause staining or damage. Do not install system components which become damaged in any way. Remove such components from Site and replace with new, undamaged material.

c. Fasten coverings to prevent removal by wind.

C. Handling of Materials:

1. Do not subject roofing tiles and accessory materials to bending or stress.

2. Do not stack tiles on roof in quantities exceeding six (6) tiles high on twelve (12)-inch centers at every third course on slope, or exceeding manufacturer recommendations.

3. Do not damage edges or handle material in a manner that will cause cracking.

4. Keep on-Site handling to a minimum.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Clay Roofing Tiles: Provide one of the following:

1. Barrel shape Clay Roofing Tile System as manufactured by:

a. Claymex Brick and Tile, Inc., Eagle Pass, TX..

b. Gladding, McBean, A Division of PABCO Building Products, LLC, Lincoln, CA.

c. Ludowici Roof Tile, New Lexington, OH.

2. Or approved equal.

B. Asphalt Membrane Flashing: Provide one of the following:

1. Bituthene Ice and Water Shield as manufactured by:

a. Construction Products Division, W.R. Grace & Company, Columbia, MD.

b. Or approved equal

2. WinterGuard as manufactured by:

a. Certain Teed Corporation, Denver, CO.

3. Or approved equal.

C. Fasteners: Provide one of the following

a. Twisted Wire Tyle-Tye System as manufactured by:

1) Newport Fastener Company, Inc., Norco, CA.

b. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Clay Roofing Tiles: Provide barrel shape roofing tiles manufactured from extruded clay, free from surface imperfections with colors derived from the clay type and the firing process,, complying with the following:

1. Type: barrel shape tile.
2. Exposure: Field tile shall have a maximum exposure of twelve (12) inches by 8-3/4 inches with three (3) inch headlap.
3. Weight: One thousand two hundred (1200) pounds per square, minimum for barrel shaped tile.
4. Texture: Smooth.
5. Special Shapes: Complete selection of manufacturer's specially shaped, color-matched, extruded and molded clay ridge caps, interlocking end band rakes, modified waterlock tile, turret shingles, eave and hip closures and starters, tile vents and top fixtures as required to complete the work. Provide all special shapes as required for a complete installation as determined by Engineer and as shown on approved Shop Drawings.
6. Colors, Blends, Patterns and Sequences: Complete selection of manufacturer’s standard and custom colors, and sequencing for both individual colors and several colors marbled within each individual tile for final selection by Engineer. Provide pattern shown on the Contract Drawings.
7. Durability: in accordance with ASTM C 1167, the clay tiles must be of a Grade compatible with the weathering index of the Project location.
8. Water Absorption: fifteen (15) percent maximum
9. Breaking Strength, Individual Tiles: one thousand (1000) pounds minimum

B. Asphalt: Provide the following:

1. ASTM D312, Type IV; softening point two hundred and twenty (220) degrees Fahrenheit
2. Asphalt Quality: Provide only virgin residual petroleum-process asphalt, which has not been modified by the addition of softening oils or other compounds to modify the softening point, and which has been accurately air-blown (oxidized) to establish the required softening point.

C. Asphalt-Saturated Underlayment: ASTM D2626, Type I, forty-three (43) pounds, organic, unperforated, thirty-six (36)-inches wide.

D. Asphalt Membrane Flashing:

1. Provide a rubberized asphalt and polyethylene membrane complying with ASTM D1970, backed with a silicone coated release paper that maintains the adhesive quality of the rubberized asphalt.

2. Provide a rubber based primer for direct adhesion to plywood roof sheathing in areas specified to receive asphalt membrane flashing.

3. Thickness: forty (40) mils total thickness minimum; four (4) mil high strength polyethylene film.

E. Bituminous Plastic Roof Cement: ASTM D4586, Type I and Type II.

F. Fasteners:

1. Provide the following for plywood and oriented strand board roof deck substrates:

a. Provide industry standard type of stainless steel nails with minimum pull-out strength of forty (40) pounds.

b. Provide annular ring or spiral groove type nails with 10 gage (0.135-inch) shank, of sufficient length to penetrate plywood deck; minimum length 1-1/4-inches.

c. Provide self-capped nails with 3/8-inch minimum diameter flat caps.

2. Provide the following for concrete deck substrates:

a. Provide a clay roofing tile fastening system which is approved by the New York City Building Code and which results in a minimally penetrated roofing membrane while locking together the rows of tiles to prevent wind damage, earthquake damage, or shifting of clay roofing tile from other causes.

b. Provide a system of twisted 0.084-inch diameter stainless steel wire ties with loops formed at six (6) inches on centers, stainless steel expansion anchors of sufficient length to penetrate the substrate 1-1/2-inches and individual tie wires of 0.084-inch diameter stainless steel.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shop fabricate all clay roofing tile shapes.

B. Provide preformed clay tile with predrilled holes for fasteners when manufactured.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Source Quality Control:

1. Obtain clay roofing tile from only one manufacturer, who publishes complete information on the specified roofing system and offers to guarantee the completed roofing installation as specified.

2. Manufacturer’s recommended installation and specification manual for clay roofing tile shall become the standard reference for materials, installation methods and recommended details. All work shall comply with this standard unless alternative details are shown on the Contract Drawings.

B. Allowable Tolerances:

1. Manufacturing Dimensional Tolerance: +/- 1/16 inch

C. Mock-Up:

1. Prior to the installation of clay roofing tile system, but after Engineer's approval of Shop Drawing and other Submittals, erect stepped-back mock-ups using substrate preparation, materials, and application techniques specified for final work on an actual area of roofing substrate to be provided with clayroofing tile system. Provide all components of the clay roofing tile system showing the correct installation, substrate preparation and the workmanship quality which shall be achieved in the Work. Build mock-ups in location approved by Engineer, approximately 12-foot square. Include methods of installation and flashing typical to the work including roof penetration, ventilation, eave, ridge, hip and valley system components and drip edge and other flashing details using all system components required for the Work. Obtain Engineer's acceptance of mock-up before start of work. Retain and protect mock-up before start of work. Retain and protect mock-up during construction as a standard of judging completed Work.

2. Build as many mock-ups as necessary in order to achieve Engineer's acceptance of the Work.

3. Clay roofing tile Work which proceeds without an approved mock-up shall be stopped, and a mock-up prepared for Engineer’s approval, at no additional expense to DEP.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection

1. The Contractor shall examine the alignment of the substrate and conditions under which the roofing tiles system work is to be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the roofing tiles system work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

2. Verify that installation of plywood roof sheathing and blocking has been completed and has been installed in compliance with manufacturer's written instructions and the recommendations of the American Plywood Association.

3. Verify that work of other trades which penetrates roof deck has been completed and that roof openings have been correctly framed.

4. Verify that decks are dry, free of ridges, warps and voids.

B. Preparation

1. Clean the substrate of all dust, dirt, debris, loose nails, and substances and interferences detrimental to the Work. Remove protrusions and cover knotholes and other minor voids in roof sheathing with sheet metal flashing metal secured with stainless steel roofing nails.
2. Install metal edge drips beneath asphalt membrane flashing at eaves and over the asphalt membrane flashing at rakes.
3. Coordinate installation with flashing, gutters, and other adjoining Work to ensure proper sequencing.
4. Comply with clay roofing tile manufacturer's approved installation and specification manual submitted to Engineer at the time of Shop Drawing approval.
5. Do not install roofing materials until all vent stack and other penetrations through roof have been installed and are permanently fastened against movement.

3.02 INSTALLATION

A. General: Comply with clay roofing tile manufacturer's written publications and recommendations for product installation as shown on Shop Drawings approved by Engineer, and applicable NRCA publications specified.

B. Install rubber-based primer for self-adhering rubberized asphalt membrane flashing following manufacturer's written instructions and only when air and surface temperatures are above forty (40) degrees Fahrenheit and weather is fair and will remain so until completion of asphalt flashing installation.

C. Install cold-applied self-adhering rubberized membrane flashing to provide ice dam protection along all roof edges and along all eaves, rakes, valleys and roof ridges. Extend eave protection membrane minimum of four (4) foot – zero (0) inches up slope beyond interior face of exterior walls, and three (3) foot – zero (0) inches minimum centered on valleys, hips, ridges and roof penetrations unless additional extension or width is shown on the Contract Drawings. Do not fold asphalt flashing.

D. Asphalt-saturated roof underlayment felts: Install one layer of forty-three (43) pound asphalt-saturated roof underlayment felt parallel to eaves.

1. Starting at low end of roof install a one (1) foot – six (6) inch width of asphalt-saturated roof underlayment felt overlapping cold-applied self-adhering rubberized membrane flashing by 2-1/2 inches.
2. Shingle plies to shed water in direction of water flow by overlapping horizontal joints between cold-applied self-adhering rubberized membrane flashing and asphalt-saturated roof underlayment felts, and between individual courses of asphalt-saturated roof underlayment, 2-1/2 inches and with vertical joint end laps overlapped six (6) inches.

3. Stagger vertical joints in felts two (2) foot – zero (0) inches minimum between courses.

4. Extend asphalt-saturated roof underlayment felts up six (6) inches at abutting vertical walls and parapets.

5. Lap asphalt-saturated roof underlayment not less than four (4) inches under edges of built-in gutters, valleys, and metal flashings.

E. Omit asphalt-saturated roof underlayment at areas of self-adhering rubberized membrane flashing except where shingling of plies in the direction of water flow is not possible and would expose unprotected material transition joints to water flow. At locations such as ridges and roof penetrations continue asphalt-saturated roof underlayment continuously over self-adhering rubberized membrane flashing. Lap asphalt-saturated underlayment over self-adhering rubberized membrane flashing as recommended by manufacturer, but not less than two (2) inches.

F. Extend asphalt flashing beneath all roof penetration flashings.

G. Install all asphalt flashing in strict compliance with manufacturer's written instruction, cutting the membrane into recommended working lengths for each condition of installation.

H. Do not leave cold-applied self-adhering rubberized membrane flashing exposed to sunlight. Cover with clay roofing tiles immediately.

I. Nailing:

1. One fastener shall be provided for each clay roofing tile of length sufficient to penetrate through plywood roof sheathing.

2. Do not drive nails hard against tile surface. Drive nails to a point where the nail head will just clear the tile so that the tile hangs on the nail.

3. Provide a bead of elastic asphaltic mastic over the heads of all nails that fasten gable, rake and ridge tiles.

J. Wire Fastening System Installation:

1. Install twisted tie lines using manufacturer’s written instructions, and Shop Drawings approved by Engineer. Use all fasteners, anchors and hold-down clips specified. Locate anchors along twisted tie at ridge, eave and midpoint of wire length. After fastening deck anchors bend over tabs through loop of twisted wire and cover with roofing mastic.

2. Secure clay tiles to twisted wire with individual wire ties. Pass wire through hole of the tile, secured on itself with a double twist and then secured to a loop at least one full space above the tile top. Install one (1) windlock clip for each tile secured by individual wire tie.

3. Where tiles overlap metal flashings, fasten tiles to deck using stainless steel wire and daubs of roofing cement.

K. Clay Roofing Tile Application for three (3) inch in twelve (12) inch or Greater Slope:

1. Beginning at eaves, install clay roofing tile with minimum of three (3) inch lap between courses of roofing tile following color blend and pattern shown on approved Shop Drawings and the Contract Drawings.

2. Install roofing tiles as recommended by the manufacturer as shown on Shop Drawings approved by Engineer. Lay tiles so butt edges form straight lines, parallel to eaves. Install matching, specially shaped tile at ridges, rakes, hips and other locations as specified.

3. Cut tile at valleys to form a straight border. Taper valleys from a two (2) inch exposure on each side of valley at top and increase exposure by one (1) inch on each side for every eight (8) feet – zero (0) inches of valley length.

4. Cut and fit tile at roof penetrations. Install metal ridge flashings and other metal flashings required as recommended by the clay roofing tile manufacturer.

5. Where field-cutting of tile is necessary comply with the following:

a. Cut tile accurately to produce needed shapes.

b. Cut tile using a power driven saw, equipped with a carbide or diamond tipped blade.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Only the original installer shall repair or replace deteriorated or defective work.

B. Adjust roofing tiles prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length.

C. Leave roofing tiles free from holes, cracks, stains and other blemishes. Do not allow construction traffic, unassociated with the clay roofing tile work, to walk or transport materials over the finished roofing tile work. Contractor shall replace damaged work with new undamaged material at no additional expense to DEP. Attempts to fill damaged or cracked tiles with mortar or other materials shall not be considered acceptable repair; remove such damaged tile from the work and replace with new as specified.

D. Replace work which does not meet the requirements of the Contract Documents for any reason at no additional expense to DEP.

E. At the completion of the work, replace adjacent work marred by the work of this Section.

F. Remove all materials and debris and leave the site of the work in clean condition.

END OF SECTION

SECTION 07 53 00 – ELASTOMERIC MEMBRANE ROOFING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for a loose-laid, ballasted, single-ply elastomeric roofing system and for a complete water- and weather-tight installation of the system complying with all governing codes and standards.

B. The Contractor shall provide all labor, materials, equipment, and incidentals necessary to perform the work of this Section as shown on the Contract Drawings, specified herein or in the Contract, or required otherwise for a complete installation.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	8
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	15
3.05	Adjusting / Protection / Cleanup	15

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 07 22 16 -- Roof Board Insulation

B. Section 07 62 00 -- Sheet Metal Flashing and Trim

1.04 REFERENCES

A. NYCBC -- New York City Building Code

B. ASTM D312 -- Asphalt Used in Roofing, Specification for

C. ASTM D395 -- Rubber Property - Compression Set, Standard Test Methods for

D. ASTM D412 -- Vulcanized Rubber and Thermoplastic Elastomers – Tension, Standard Test Methods for

E. ASTM D471 -- Rubber Property - Effect of Liquids, Standard Test Method for

F. ASTM D542 -- Index of Refraction of Transparent Organic Plastics, Standard Test Method for

G. ASTM D573 -- Rubber - Deterioration in an Air Oven, Standard Test Method for

H. ASTM D624 -- Tearing Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers, Standard Test Method for

I. ASTM D1149 -- Rubber Deterioration - Cracking in an Ozone Controlled Environment, Standard Test Methods for

J. ASTM D2137 -- Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics, Standard Test Methods for

K. ASTM D2240 -- Rubber Property - Durometer Hardness, Standard Test Method for

L. FM 1-28 -- FM Global Property Loss Prevention Data Sheet, Wind Design

M. FM 1-29 -- F Global Property Loss Prevention Data Sheet, Roof Deck Securement and Above-Deck Roofing Components

N. FM 1-28R -- FM Global Property Loss Prevention Data Sheets, Roof

Systems

O. FM 1-49 -- FM Global Property Loss Prevention Data Sheet, Perimeter Flashing

P. South Coast Air Quality Management District (SCAQMD)

1. Rule 1113 -- Architectural Coatings
2. Rule 1168 -- Adhesives and Sealants

1.05 DESCRIPTION

A. The single-ply roofing system to be provided under this Section shall include a complete system of loose-laid elastomeric roofing laminated to a non-woven polyester fleece backing which is capable of direct installation on composite roof insulation without the use of an intermediate protection board and is provided with elastomeric base flashing. The system shall also include all materials and system components required for puncture protection, heavy duty roof walkway, one-way breather vents, and other features necessary to complete the Work.

B. Installation of the System shall meet the requirements of FM Approval Rating Class 1-90 construction for composite cementitious wet fill insulation substrates. The work of this Section shall also be coordinated with the results of Sections 07 22 16-Roof Board Insulation and 07 62 00 – Sheet Metal Flashing and Trim, and the FM publications referenced above.

C. Sustainable Design Requirements: Products applied on Site and within the building's weatherproofing system shall comply with VOC limits of authorities having jurisdiction and the following VOC limits of when calculated according to SCAQMD Rule 1113 and Rule 1168:

1. Multipurpose Construction Adhesive: VOC not more than 70 g/L.
2. Plastic Foam Adhesives: VOC not more than 50 g/L.
3. Single-Ply Roof Membrane Sealants: VOC not more than 450 g/L.
4. Nonmembrane Roof Sealants: VOC not more than 300 g/L.
5. Sealant Primers for Nonporous Substrates: VOC not more than 250 g/L.
6. Sealant Primers for Porous Substrates: VOC not more than 775 g/L.
7. Other Adhesives and Sealants: VOC not more than 250 g/L.

D. Project-specific system/design requirements will be provided in the Contract (if necessary) to update the requirements given herein or to supplement other requirements given in the Contract Drawings.

E. Scheduling:

1. Proceed with the roofing and associated work only after curbs, blocking, continuous wood sleepers, vents, drains, and projections through the

substrate have been installed, and when the substrate construction and framing of openings is completed.

2. Proceed with and complete the Work only when materials, equipment, and skilled tradesmen required for the installation of other roofing membrane system components are at the Site and are ready to follow with the Work immediately after composite roof insulation is acceptable for installation of the complete single-ply roofing system.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer skilled, trained, and with successful experience in the installation of single-ply roofing systems, who is a recognized roofing contractor, with specific skill and successful experience in the type of roofing specified, and equipped to perform workmanship in accordance with the Contract Documents, manufacturer's written instructions for guaranteed construction and the approved Shop Drawings and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owners, architects, or engineers responsible for projects.

b. Approximate contract cost of the single-ply roofing system.

c. Amount of area installed.

2. The roofing installer shall be an approved roofing applicator who has qualified for appointment and has been trained by the manufacturer.

3. Proof of acceptability of installer by manufacturer to Engineer.

B. Performance Criteria: Provide the following:

1. Except as otherwise shown, comply with the written specifications and recommendations of the roofing manufacturer. In addition, comply with FM Publication 1-28 Technical Advisory Bulletin for Class 1-90 wind uplift resistance. Select appropriate entries in Table 3 of 1-28 for submission to Engineer for approval.

2. Single-ply roofing system, base and other flashings shall be permanently weather- and watertight and not deteriorated in excess of manufacturer's published limitations.

3. Provide stone ballast weight distributions over entire roof surfaces in all areas not shown to receive heavy-duty roof walkway pavers and pedestal system. Comply with FM wind uplift criteria, ballast and paver locations, weights of materials required in fields, perimeters, and corners of roof areas, and approval recommendations contained in 1-29 paragraph 2.7 'Single-Ply Membrane Covers: General.'

4. Provide heavy-duty walkway protection pavers at all traffic concentration points regardless of traffic frequency and whether or not shown.

5. Specified manufacturer's installation and product specifications and details, unless more stringent criteria shown or specified, is acceptable to the single-ply roofing system manufacturer specified.

C. Requirements of Regulatory Agencies:

1. Comply with applicable insurance rating bureau requirements as required by the New York City Building Code, unless more restrictive requirements are specified.

2. Provide materials and roofing systems which have been tested, listed and labeled by Underwriters Laboratories' Incorporated for Class "A" rating, and bear the UL label on each package or are shipped to the Site with a UL Certificate of Compliance.

3. Provide roofing materials which have been tested, listed and FM labeled for Class "A" maximum flame spread rating.

4. The Office of Technical Certification and Research (OTCR) of the New York City Department of Buildings: Where, in order to be incorporated into the work, a particular item or product system specified by Engineer requires acceptance by the New York City Commissioner of Buildings, Contractor shall ensure that the product manufacturer has obtained such approval, without additional expense to DEP, and in providing DEP with an approved certified copy from the Approved Independent Agency, for the item or product system which shall be submitted to Engineer as part of the Shop Drawing approval process. Contractor may submit, in place of products specified by Engineer, products which are "equal" in all ways to the product specified that is NYC code prescribed or an alternate to the code. Such "or approved equal" product submissions shall not change the requirements of these Sections as to performance, required features or properties, as determined by Engineer, and shall not require additional compensation to Contractor or additional expense to DEP. Final acceptance of "equal" is at the sole determination of Engineer

5. Comply with all applicable requirements of governing authorities and codes for all Work.

6. In those instances where the Commissioner of Buildings requires a certificate of compliance of the manufacturer or producer certifying that the item or product system was tested and is equivalent to material of the same kind and quality regularly being manufactured by such manufacturer or producer Contractor shall provide all such certificates to the Commissioner of Buildings without additional expense to DEP.

D. Source Quality Control:

1. Obtain elastic sheets from only one manufacturer, who publishes complete information on the specified roofing system, and offers to guarantee the completed roofing installation as required.

2. Take field dimensions prior to preparation of Shop Drawings.

E. Allowable Installation Tolerances:

1. Do not install Work until substrate preparation and tolerances have been approved by Engineer, single-ply roofing system manufacturer's Technical Representative and the single-ply roofing system installer and Contractor have verified to Engineer that substrates are within tolerances specified and acceptable to produce approved Work. Work advanced for any reason without such verification shall be stopped, removed and replaced with new material after substrate is approved at no additional expense to DEP.

2. Substrate Tolerances:

a. Out-of-Plane: 1/8 inch maximum in 10 foot - 0 inches and 1/16 inch maximum in any 12 inches measured along the plane.

b. Maximum Offset in Plane Alignment: 1/16 inch.

c. Variation From Slope: 1/8 inch maximum in 10 foot - 0 inches.

1.07 SUBMITTALS

A. The Contractor shall submit the following for review and approval by the Engineer:

1. Samples: Submit for approval the following:

a. 12-inch by 12-inch sheet of each item specified and 6-inch long pieces of each required system component to be used in the Work.

b. Each fastener type required marked as to its type of material and with its intended purpose in the Work.

c. All components of the single-ply roofing system, flashing, and ballast systems labeled with their intended uses in the Work.

2. Shop Drawings: Submit for approval the following:

a. Shop Drawings which are completely dimensioned using field-verified dimensions on plans of each roof area. Drawings must also include accurate locations of all roof penetrations, roof mounted equipment, curbs, skylights, and other features on the roof as specified by the Engineer. Contractor shall submit all details requiring consideration and the performance of the details shall be approved by the single-ply roofing system manufacturer for guaranteed construction as specified.

b. Manufacturer's specifications and product manuals indicating product information correlated to specified requirements,

manufacturer's installation instructions, maintenance instructions and other data as may be required by Engineer.

c. Copies of the FM Global Property Loss Prevention Data publications and appropriate Technical Advisory Bulletins published by Factory Mutual indicating compliance with wind uplift pressure-resistant performance criteria, ballast and paver requirements and the requirements for FM Approved 1-90 system construction and perimeter securement conditions.

3. Contractor's Review: Accompanying approval request, submit to Engineer a written statement signed by Contractor, stating that the Drawings and Sections for roofing and flashing have been reviewed with an agent of the roofing material manufacturer and that he is in agreement that the selected systems are proper, compatible and that the details shown are not in conflict with the roofing manufacturer's roofing and flashing details. Show by copy of transmittal form that a copy of the statement has been transmitted to the manufacturer.

4. Statement of Application: Upon completion of the Work, submit a statement to the Engineer signed by the Contractor stating that the Work complies with the requirements of these Sections and the installation methods comply with the manufacturer's printed instructions and were proper and adequate for the conditions of installation and use.

B. Sustainable Design Submittals:

1. VOC Reporting Form. Provide the following information:

a. For all adhesives and sealants, applied on site and within the building’s weatherproofing system, provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver materials to the site in sufficient quantities to ensure uninterrupted progress of the Work.

2. Deliver materials in manufacturer's original, unopened containers and rolls with labels intact and legible.

3. Materials requiring fire resistance classification shall be delivered to the job with labels attached and packaged as required by labeling service.

B. Storage of Materials:

1. Store materials in a dry, well ventilated, weather tight place, and in a manner which will ensure that there is no possibility of significant moisture pick-up.

2. Store in a manner which complies with fire and safety regulations.

3. Store emulsions at temperatures above 40 degrees Fahrenheit.

C. Store materials on clean raised platforms with weather protective covering when stored outdoors. Handling of Materials:

1. Handle rolled goods so as to prevent damage to edges or ends.

2. Select and operate material handling equipment so as not to damage existing construction or applied roofing.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Firestone: RubberGard EcoWhite EPDM Roofing System;

2. Sitka Sarnafil: EcoSmart Roofing System;

3. Or an approved equal.

2.02 MATERIALS / EQUIPMENT

A. Loose-Laid Roofing Systems: Provide the following:

1. Ethylene Propylene Diene Monomer Synthetic Rubber Sheeting: Provide white synthetic rubber sheeting laminated to a 0.075-inch thick non-woven polyester fleece backing. Comply with the following:

a. Rubber Membrane Thickness (not including polyester backing):

1) 0.060-inches for base flashings.

2) 0.060-inches for loose-laid system.

b. Hardness Durometer A, ASTM D2240: 60 ±10 points

c. Tensile Strength, ASTM D412: 1305 pounds per square inch minimum

d. Elongation at Break, ASTM D412: 500% minimum at 75 F

e. Brittleness Temperature, ASTM D2137: -75 F

f. Tear Resistance, ASTM D624: 175 pounds per linear inch minimum

g. Flame Resistance, ASTM D542: No flame

h. Resistance to Heat Aging, Change in Original Properties after 70 hours at 212 F, ASTM D573: Hardness +10 points maximum, Elongation -40 percent maximum, Tensile Strength -15 percent maximum

i. Resistance to Oil Aging, Change in Volume after 70 hours Immersion in ASTM No. 33 oil at 212 F, ASTM D471: +80 percent

j. Resistance to Ozone, Condition after Exposure to 100 pphm Ozone in Air for 168 hours at 104 F, ASTM D1149: No cracks

k. Resistance to Permanent Set, Compression Set after 22 hours at 158 F, ASTM D395: +10 percent maximum

l. Resistance to Water, Change in Weight after 7 days Immersion at 158 F, ASTM D471: 2.0% maximum change in mass

B. Ballast: Provide the following two types of ballast systems in the areas shown:

1. River Washed Stone: Provide the following:

a. Smooth, rounded, river washed stone from 3/4-inch to 1-1/2-inch in diameter applied at the rate of 1,200, 1,500 and 1,800 pounds per square, (depending on location based on FM criteria) spread evenly over the surface without adhesive.

b. Provide granite or other stone capable of withstanding exposure without deterioration.

c. Comply with FM Publication 1-28 for stone ballast.

2. Heavy-Duty Roof Walkway Pavers and Pedestal System: Provide the following:

a. 2-inches thick by 18-inches wide by 18-inches long; interlocking extruded 8000 pounds per square inch precast concrete pavers weighing 24 pounds per pound square foot.

b. Provide water absorption less than 5 percent by weight.

c. Density: 166 pounds per cubic foot.

d. Provide welded wire reinforcing for all pavers.

e. Provide separate pedestal point support drainage system, each pedestal 5-1/2-inches square and 5/8-inches deep with additional thicknesses (multiple stacking) as necessary in order to provide a uniformly leveled non-sloping paver surface. Provide eight support points for each paver.

f. Color: 4079-D.

g. Provide pressed concrete drain grates matching paver size.

C. One-Way Breather Vents:

1. Provide one-way breather vents recommended by the manufacturer for single-ply roofing installation.
2. Coordinate adhesives and sealants for full system responsibility.
3. Provide black body with gray top for single-ply installation.

D. Miscellaneous Materials: Provide the following:

1. Splice Cleaner: Cleaning solution for EPDM containing toluene, heptane, carbon black and isopropanol.
2. Bonding Adhesive: Two-part spray-applied polyurethane foam catalyzed as required by installation temperature range encountered.
3. In-Seam Sealant: Silicone.
4. Splicing Cement: Butyl adhesive.
5. Lap Sealant: EPDM elastomeric sealant.
6. Protection Mats: Provide polypropylene needle-punched fabric material weighing 5.3 ounces per square yard and recommended by the roofing manufacturer for use beneath all pedestrian plaza pavers and all ballast in all areas.
7. Deck Primer: As recommended by sheet manufacturer.
8. Asphalt: ASTM D312, Type III. Softening Point: 185 degrees F-205 degrees F
9. Rubber Fastening Strips: As required by roofing manufacturer for fully guaranteed construction.
10. Termination Bars: Continuous 2-inch by 1/4-inch Type 316 stainless steel.
11. Rubber Fastening Strips: As required by roofing manufacturer for fully guaranteed construction.
12. Other miscellaneous and accessory materials required for guaranteed construction.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shop fabricate all special flashings shown using sheeting specified.

B. Use manufacturer's standard sheet seaming system for "plastic welding" or lapped joints to create seams of strength equal to sheet strength.

C. Include edge sealer to cover exposed sheet edges.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall examine the substrate and the conditions under which the single-ply roofing system and base flashing Work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Verify the adequacy of slope-to-drain, compressive strength, moisture content, and other composite roof insulation features important to the successful installation of the single-ply roofing system, flashing and ballast systems before start of Work.

3.02 INSTALLATION

A. General:

1. Follow all applicable installation instructions and recommendations contained in the single-ply roofing system manufacturer's written installation and product manuals and the information contained on approved Shop Drawing submittals. Where Contractor wishes to deviate from written installation and product manuals and approved Shop Drawing submittals all such deviations shall be submitted to Engineer for approval along with single-ply roofing system manufacturer's written agreement and a statement of acceptability for compliance with guaranteed construction.

2. Begin installation only in the presence of the single-ply roofing system manufacturer's technical representative.

3. Cut sheets to the maximum size possible, in order to minimize seams and to accommodate contours of the deck. Do not seam within four feet of roof drains.

4. Clean all splices and lap areas using manufacturer's recommended splice cleaner.

5. Lap sheets and bond joints using the seaming system recommended by the manufacturer.

6. Cover top edges of each sheet at seams with uniform fillet of special sealant.

7. Install one-way breather vents as recommended by the single-ply roofing system manufacturer as shown but not less than one per 1000 square feet.

8. Install all roofing and associated work in a manner that will insure a complete roofing system at the end of each day’s work. Do not advance the installation of any one material beyond that which is necessary for proper sequencing of the single-ply roofing system Work.

B. Pre-installation Conference:

1. Prior to the installation of the single-ply roofing system and associated Work, Contractor shall schedule and meet at the Site with the roofing

installer, the installer of each component of associated Work, the installers of deck and composite insulating substrate construction to receive roofing Work, the installers of other Work in and around roofing which must follow the roofing work, including mechanical work, the Engineer, and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the single-ply roofing system Work, including but not necessarily limited to, the following:

a. Review project requirements, including Drawings, Sections and other Contract Documents.

b. Review required submittals, both completed and yet to be completed.

c. Review status of substrate including drying, structural loading limitations and similar considerations.

d. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

e. Review required inspection, testing, certifying and accounting procedures.

f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

g. Review regulations concerning code compliance, FM compliance, environmental protection, health, safety, fire and similar considerations.

h. Review procedures needed for protection of roofing during the remainder of the construction period.

2. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

3. Record any revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

C. Environmental Conditions:

1. Proceed with roofing and associated work only when weather conditions will permit unrestricted use of materials and quality control, complying with the Section requirements and with the recommendations of the roofing materials manufacturers.

2. Proceed only when Contractor and his installer are willing to guarantee the Work as required and without additional reservations and restrictions.

3. Record decisions, conditions and agreements to proceed with the Work when weather conditions might be unfavorable. State the reasons for proceeding, with the names of the persons involved along with the changes, if any, or revisions, requirements or terms of the Contract.

D. Loose-Laid Ballast System:

1. Clean dry splice areas using manufacturer's recommended splice cleaner. Follow manufacturer's recommendations for cleaning.

2. Apply splicing cement to both mating surfaces with either a three or four inch wide 1/2-inch medium nap roller or 1/2-inch thick paint brush. Apply cement smoothly and evenly to obtain 100 percent coverage. Do not allow the cement to glob or puddle.

3. While the splicing cement is drying, apply a 5/32-inch diameter bead of in-seam sealant (no less than 1/8 inch and no more than 1/4 inch wide) within 1/2 inch of the inside edge of the bottom sheet.

4. Maintain a continuous bead of in-seam sealant on all membrane and cured flashing splices, especially at splice intersections.

5. Allow the cement to dry until it is tacky but will not string or stick to a dry finger touch and will not move when pushed with a dry finger.

6. Roll the top sheet onto the mating surface. Take care not to stretch or wrinkle the membrane sheet and assemble the seam with hand pressure by wiping toward the splice edge.

7. Immediately roll the splice with a two inch wide steel roller, using positive pressure, toward the outer edge of the splice. Do not roll parallel to the splice edge. On a completed splice, the in-seam sealant must remain evident or sensitive to the touch.

8. Wait at least two hours; check the splice edge for dust, dirt or other contaminants. If necessary, clean the splice edge by scrubbing with warm soapy water; rinse with clean water and allow to dry.

9. Clean the dry splice edge, extending at least 1 inch onto the top and bottom membranes, using a clean cloth dampened with splice cleaner and apply a 5/16 inch (minimum 1/4 inch) diameter bead of lap sealant to completely cover the splice edge.

10. Feather the lap sealant using roofing manufacturer's preformed tool so that the high point or the crown of the lap sealant is directly located over the edge of the splice.

11. Bond single-ply roofing system to vertical surfaces at edges of the membrane and at penetrations through the membrane. Contractor shall bond the membrane into rain drainage work. Apply matching adhesive tape where recommended to reinforce the attachment.

12. Install protection mats in a uniform continuous plane beneath all ballast. Extend protection mats a minimum of 2 inches above the anticipated ballast level at perimeter flashings and at penetrations with all edges overlapped at least six inches.

13. Apply ballast course in uniform thicknesses, at rate identified on approved Shop Drawings, in each area of the Work, exercising extreme care to minimize possibility of damage to membrane.

E. Heavy-Duty Roof Walkway Pavers and Pedestal System:

1. Install protection mats in a continuous plane beneath all areas to receive pedestrian pavers.

2. Extend protection mats a minimum of two inches above the anticipated ballast level at the perimeter flashings and around penetrations except for roof drains with all edges overlapped a minimum of six inches.

F. Install paver piers and provide multiple stacking of 1/16 and 1/8 inch shims to achieve a level plane with no noticeable unevenness. Provide eight contact support points for each paver.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Before placing any ballast on single-ply roofing system membrane, and after all elastic sheet and flashing seams have been sealed, conduct in-place water retention tests.

2. Plug drains and flood roof with two inches of water above roof high points. Let water remain in-place for 24 hours. Do not add additional water during the time of the test and schedule testing during a period when precipitation is not predicted. If precipitation occurs during the time of the test, redo test when precipitation is not predicted during the time of the test. Calculate expected evaporation at temperatures, humidity and wind conditions occurring during the time of the tests.

3. Measure water remaining in place at the high point of roofs. Roof areas which demonstrate loss of water, that cannot be explained by loss due to evaporation, shall be inspected by a Technical Representative of the single-ply roofing system manufacturer and the source of leaks determined and presented to DEP and the Engineer as part of a field report which shall also make recommendations for remedial Work. Where the source of leaks cannot be determined, the single-ply roofing system shall be removed and replaced with new single-ply roofing system at no additional expense to DEP. All material and construction systems damaged by the results of this test shall be replaced with new at no additional expense to DEP.

4. After remedial repairs have been made and inspected by a representative of the single-ply roofing system manufacturer and judged to be watertight, repeat the water retention test. If, this test shows that the single-ply roofing system is still not retaining water according to expected results, remove the entire single-ply roofing system and replace with new at no additional expense to DEP.

B. Inspection and Acceptance

A. At the end of the construction period, or at a time when the remaining construction Work will in no way affect or endanger the single-ply roofing system and associated Work, a technical representative of the single-ply roofing system manufacturer shall make a final inspection of the Work and prepare a written report to DEP and Engineer of deterioration, damage or deficiencies found in the Work.

B. Only the installer shall repair or replace deteriorated or defective Work.

C. Certify that the completed Work is in accordance with the Sections, and without damage or deterioration (except for normal weathering) at time of Final Acceptance.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protect single-ply roofing system from damage during the construction period so that it will be undamaged in any way at the time of Final Acceptance by DEP.

1. Provide continuous protection of materials against wetting and moisture absorption.

2. Protect materials against damage by construction traffic.

B. Protect other Work, and surfaces of membrane, from spillage of single-ply roofing system sealing and bonding materials, and prevent materials from entering and clogging drains and conductors.

C. Replace Work which is soiled or otherwise damaged by the performance of the single-ply roofing system and associated Work and from improper installation techniques.

D. Remove broken, cracked and chipped pedestrian plaza pavers and replace with undamaged material.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for sheet metal flashing and trim for a complete water- and weather-tight installation complying with all governing codes and standards.

B. The Contractor shall provide all labor, materials, equipment, and incidentals necessary to perform the work of this Section as shown on the Contract Drawings, specified herein or required otherwise for a complete installation.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	8
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A.	Section 03 45 00	–	Precast Architectural Concrete
B.	Section 04 22 00	–	Concrete Unit Masonry
C.	Section 07 53 00	–	Elastomeric Membrane Roofing
D.	Section 07 90 00	–	Joint Protection

1.04 REFERENCES

A.	NYCBC	–	New York City Building Code
B.	ASTM A666	–	Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
C.	ASTM B32	–	Standard Specification for Solder Metal
D.	FM 1-49	–	FM Global Property Loss Prevention Data Sheet, Perimeter Flashing
E.	SMACNA	–	Sheet Metal and Air Conditioning Contractors National Association, Incorporated, Architectural Sheet Metal Manual

1.05 DESCRIPTION

A. Sheet metal flashing and trim to be provided under this Section shall include complete systems of flashing and counterflashing at penetrations in roofing; interlocking, mechanically-keyed, three-way ribbed stainless steel metal masonry cavity wall flashing, and miscellaneous system components such as cast-in-place and built-in-place reglets and other accessory components; miscellaneous flashings not supplied under the work of other Sections; miscellaneous accessories, fasteners and incidental system components.

B. Installation of the systems shall meet the requirements of FM Approval Rating Class 1-90 construction, without relying upon sealants or other non-metallic detailing and fabricating techniques to achieve weather- and water tightness.

C. Performance Criteria:

1. Sheet metal flashing and trim shall be permanently watertight and not deteriorate in excess of manufacturers' published limitations.

2. Comply with fabrication details recommended by SMACNA and the sheet metal flashing and trim manufacturers, as approved by Engineer at time of Shop Drawing submission.

3. Provide completely weather- and watertight wall and single-ply roofing metal flashing systems. Contractor shall provide only the highest quality materials and methods of construction and installation as recommended by sheet metal flashing and trim manufacturers in compliance with governing

authorities and as approved by Engineer at time of Shop Drawing submission.

D. Sustainable Design Requirements

1. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content shall not be less than 25 percent.

2. Low Emitting Materials: All adhesives and sealants used on Site and within the building's weatherproofing system shall meet the VOC content limits for the work as specified in the Contract Documents.

E. Project-specific system/design requirements will be provided (if necessary) in the Contract in order to update the requirements given herein or to supplement other requirements given in the Contract Drawings.

F. Scheduling:

1. Coordinate ribbed metal cavity wall flashings with other Work to ensure secure anchorage and watertight seals, and to minimize exposure to puncture or other damage from the work of other trades. Refer to Sections 04 22 00 - Concrete Unit Masonry and 07 53 00 - Elastomeric Membrane Roofing.

2. Deliver materials to the site in sufficient quantities to ensure uninterrupted progress of the Work.

3. Do not proceed with the sheet metal flashing and trim Work until curb and substrate construction, blocking, and other construction to receive the Work is completed.

4. Schedule the installation of sheet metal flashing and trim Work to coincide with the installation of roofing, waterproofing, drains, piping, blocking, nailers, framing at openings, curbs, Concrete Unit Masonry, and other adjoining and substrate Work.

5. Proceed with and complete the Work only when materials, equipment, and knowledgeable tradesmen required for the installation of sheet metal flashing and trim systems are at the Site and are ready to follow and integrate the Work of this Section with Work requiring the installation of sheet metal flashing and trim.

1.06 QUALITY ASSURANCE

A. Engage installers skilled, trained and with successful experience in the detailing, fabrication and installation of each type of sheet metal flashing and trim work required who are recognized sheet metal contractors, equipped to perform workmanship in accordance with the Contract Documents and approved Shop Drawings so that there will be undivided responsibility for the performance of each flashing and trim component of the Work.

1.07 SUBMITTALS

A. The Contractor shall submit the following to the Engineer for review and approval:

1. Installer Qualifications: Submit names and qualifications to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owners, architects, or engineers, responsible for the projects.

b. Approximate contract prices for sheet metal flashing and trim.

c. Size of area installed

2. Samples:

a. Typical examples of sheet metal flashing and trim profiles, 12-inches long with all fasteners, clips, and supports required for the Work. 12-inch by 12-inch sheet of each item specified and 6-inch long pieces of each required system component to be used in the Work.

b. Each fastener type required marked as to type of material and with their intended purpose in the Work.

3. Shop Drawings:

a. Copies of manufacturers' specifications, installation instructions, and recommendations for sheet metal flashing and trim requirements.

b. Manufacturer's data substantiating that the materials comply with the requirements.

c. Shop Drawings showing the coordination of the Work with Sections 03 45 00 – Precast Architectural Concrete, 04 22 00 – Concrete Unit Masonry and 07 53 00 – Elastomeric Membrane Roofing.

d. Detailed Shop Drawings showing all profiles of sheet metal flashing and trim systems to be used in the Work, fully dimensioned, located, quantified, and presented such that sequence of installation is acceptable to each interfacing material supplier.

e. Large scale isometric drawings of all sheet metal and trim intersections and transitions, include all fastener locations and materials, cleats and other miscellaneous accessories necessary to complete the Work as specified.

B. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

C. Percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver materials in manufacturers' original, unopened, and undamaged containers and rolls, with labels intact and legible and with information accurately representing container contents as approved by Engineer at time of Shop Drawing submission.

2. Items delivered in broken, damaged, rusted, or unlabeled condition shall immediately be removed from Project Site and not offered again for approval by the Engineer.

B. Storage of Materials:

1. Store materials in an area protected from all construction traffic not associated with the Work of this Section.

2. Store materials off the ground and in same package in which they were shipped, and on platforms protected from dirt and other contamination.

3. Store under cover and in a manner which does not permit water to remain on units.

C. Handling of Materials:

1. Protect all sheet metal flashing and trim work from dents, scratches, warps and bends.

2. Immediately after installation of each system component, remove all strippable protective films.

3. Comply with manufacturer's instructions for handling and installation of the ribbed metal cavity wall flashing materials, except where more stringent requirements are shown or specified.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Through-Wall Ribbed Sheet Metal Flashing (Stainless Steel):

1. Cheney Flashing Company, Inc.; Cheney Flashing – Trenton, NJ.

2. Or approved equal.

B. Reglets:

1. Cheney Flashing Company, Inc., Trenton, NJ.

2. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Stainless Steel Flashings Associated with Single-Ply Roofing:

1. Provide through-wall sheet metal flashing for embedment in masonry with ribs at three-inch intervals along length of flashing to provide an integral mortar bond.

2. Provide sheet stainless steel, Type 316 complying with ASTM A666, with No. 2D dead soft, fully annealed finish, unless required to be harder temper for proper forming and performance for application indicated.

3. Provide thickness of 0.0156 inch.

4. Provide stainless steel flashing and counterflashing at penetrations in single- ply roofing.

B. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.

1. Material: Stainless steel, 0.0187 inch thick.

2. Select reglet types required from subparagraphs below.

3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

5. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

6. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

C. Miscellaneous Materials:

1. Solder for Stainless Steel: ASTM B32, Lead-free; 96.5% Sn, 3.45% Cu, 1% Sb, 0.05% Ag used with an acid flux of the type recommended by the stainless steel manufacturer. Use a non-corrosive rosin flux over tinned surfaces.

2. Stainless Welding Rods: Type recommended by stainless steel sheet manufacturer for the type of metal sheets furnished.

3. Nails, Screws and Rivets: Same material as flashing sheet, or as recommended by manufacturer of flashing sheet.

4. Cleats: Same metal and gage as sheet being anchored, two-inches wide, punched for two anchors.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabricated Metal Flashing and Trim: Shop fabricate sheet metal flashing and trim to comply with profiles and sizes shown, and to comply with manufacturer's recommended details. Except as otherwise shown or specified, provide soldered flat-lock seams, and fold back metal to form a hem on the concealed side of exposed edges. Comply with metal producers' recommendations for tinning, soldering and cleaning flux from metal.

B. On all metal base and counterflashing, and trim provide completely shop-fabricated corners and special flashings; arc welded to insure watertight joints. Grind welds smooth so as to be indistinguishable from adjacent surfaces

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall examine the substrate and the conditions under which the sheet metal flashing and trim Work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Preparation

1. Clean the substrate of dust, debris, substances, and interferences detrimental to the Work and prepare substrates as recommended by the sheet metal manufacturer.

3.02 INSTALLATION

A. General:

1. Separate dissimilar metals from substrates and from each other by painting each metal surface in the area of contact with a 15-mil thick application of bituminous coating, as recommended by the manufacturers of the dissimilar metals. Comply with manufacturer's recommendations for other forms of protection of the stainless steel and aluminum against corrosion.

2. Provide thermal expansion for running trim, flashing and other items exposed for more than 15 feet - 0 inch continuous length. Maintain a watertight installation at expansion seams. Locate expansion seams at 15 feet - 0 inch intervals, and 2 feet - 0 inch each side of corners and intersections.

3. Fabricate and install the Work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat, double-locked seams with cleats rolled into the seam and with minimum exposure of solder, welds, and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges. All exposed edges of all sheet metal flashing shall be hemmed not less than 1/2-inch wide.

4. Conceal fasteners and expansion provisions wherever possible in exposed work and locate so as to minimize the possibility of leakage. Cover and seal work as required for a watertight installation.

5. Provide cleat-type anchorages for metal flashings and trim wherever practical, arranged to relieve stresses from building movement, and thermal expansion and contraction.

6. On vertical surfaces lap two-piece flashings a minimum of four inches.

7. On sloping surfaces, for slopes of not less than six inches in 12 inches, lap unsealed flashings a minimum of 6 inches. For slopes less than six inches in 12 inches, use soldered flat-locked seams.

8. For embedment of metal flashing flanges in single ply roofing or flashing or stripping, extend flanges for a minimum of six inches embedment.

9. Flashing to be inserted into reglets shall be installed to the full depth of the reglet with the top flange of the flashing edge turned forward to form a hook. Caulk flashing into reglets using stainless steel wedges. Fill reglet with sealant specified in Section 07 90 00 - Joint Protection.

B. Installation of Stainless Steel Flashing and Trim:

1. Tin the edges of plain stainless steel to be soldered, for a width of 1-1/2 inches, using solder for stainless steel and acid flux. Remove every trace of acid flux residue from the metal promptly after tinning or soldering.
2. Provide welded joints. Provide upturned, 1/2-inch wide hooked flanges, and weld between adjoining sheets; lay seam flat.

C. Installation of Ribbed Metal Cavity Wall Flashing:

1. Build ribbed metal through-wall masonry flashing work into Concrete Unit Masonry construction as construction work progresses. Work performed without built-in flashings shall be stopped, removed and rebuilt at no additional expense to DEP, even if discovered only after walls and other materials are in-place and completed.
2. Install all flashings in a split bed of mortar, increasing the thickness of the bed if required to achieve full mortar coverage on top and bottom of flashings.
3. Coordinate the installation of flashing materials and associated work so as to provide a complete system complying with the combined recommendations of manufacturers and installers involved in the work.
4. Use only installation techniques approved by the ribbed metal cavity wall flashing manufacturer

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Quality Control for Cavity Wall Flashing

1. Field test ribbed metal cavity wall flashing after installation. After building three courses of concrete unit masonry above area of ribbed cavity wall flashing, tape weep vents closed and fill cavity with water.
2. Water leaking from the wall below the area of the ribbed metal cavity wall flashing shall be evidence that the ribbed metal cavity wall flashing was improperly installed.
3. Remove concrete unit masonry and improperly installed ribbed cavity wall flashing and install new ribbed cavity wall flashing. Repeat this process until the wall does not shown evidence of leakage beneath ribbed cavity wall flashing. All such remedial work shall be at no additional expense to DEP.
4. Remove tape from weep vents and all mortar and other debris from cavity and demonstrate free flow of water from the cavity at conclusion of test

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide continuous protection of metal flashing and trim materials against wetting, contamination and other damage primarily by storing materials under cover and above ground and away from all construction traffic.

B. Do not permit workmen, or others, to step directly on flashing sheets in place, or to place or move equipment over flashing and trim surfaces. Protect surfaces during installation of permanent covering Work and adjoining Work.

C. Neutralize excess flux as work progresses with five percent to ten percent washing soda solution and rinse thoroughly.

D. Clean exposed surfaces of every substance which is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces. Exercise extreme care to remove fluxes and ferrous metal particles, including welding splatter and grinding dust.

E. Do not leave metal debris and discarded materials at the Site of the Work. Clean each site of the Work as the Work progresses on a daily basis.

END OF SECTION

SECTION 07 71 00 – ROOF SPECIALTIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Principal items of Work under this Section include:

1. Preformed copings
2. Closures, trim, fasteners, sealants, and accessories for fabricating and installing Work under this Section.
3. Roof curbs.
4. Metal Fascia.

B. Furnish all labor, materials, equipment, and incidentals necessary to perform the Work of this Section as specified, shown on the Contract Drawings or required for a complete job.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	8
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry

B. Section 07 53 00 - Elastomeric Membrane Roofing

C. Section 09 91 00 - Painting

1.04 REFERENCES

A. ASTM Standards:

1. ASTM A480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip, Standard Specification for

2. ASTM A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, Standard Specification for

3. ASTM A666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar, Standard Specification for

4. ASTM D1187 - Test Method for Asphalt-Base Emulsions for use as Protective Coatings for Metal, Standard Specification for

5. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free, Standard Specification for

B. Trade Standards:

1. Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual" (SMACNA)

2. The American National Standard Institute / Single Ply Roofing Industry “ES-1” (ANSI/SPRI)

1.05 DESCRIPTION

A. System Design Requirements: Roof Specialties system shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Thermal Expansion and Contraction:

a. Completed Roof Specialties and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, or reducing performance ability.

b. The design temperature differential shall be not less than 220 degrees Fahrenheit.

2. Uniform Wind Load Capacity:

a. Installed Roof Specialties system shall withstand negative wind pressures complying with the following criteria.

1) Design Code: ANSI/SPRI "ES-1"

2) Safety Factor: 2.0

3) The wind load criteria found on the Contract Drawings.

b. The nominal capacity of the system shall be determined based on physical testing in accordance with ANSI/SPRI ES-1. The allowable load carrying capacity shall be calculated by reducing the calculated nominal capacity by the safety factor listed herein.

3. Metal thicknesses of exposed sheet metal components shall meet the requirements of ANSI/SPRI ES-1 Table 5.

B. Accessories and items essential for the completeness of the installation shall be of the same kind of material as the item to which they are applied.

C. Sustainable Design Requirements:

1. Recycled Content of Steel-Sheet Roof Specialties: Postconsumer recycled content plus one-half of pre-consumer recycled content shall not be less than 25 percent.

1.06 QUALITY ASSURANCE

A. The workmanship of sheet metal work, method for forming joints, anchoring, cleating, and provisions for expansion shall conform to the standard details and recommendations of the Copper Development Association and the Architectural Sheet Metal Manual published by SMACNA. Workmanship shall be in accordance with the best trade practice and recommendations and specifications of the Sheet Metal and Air Conditioning Contractors National Association, Incorporated.

1. Uplift requirements shall match the requirements for adjacent membrane roofing as specified in Section 07 53 00 – Elastomeric Membrane Roofing .

2. Wind resistance calculation shall be designed specifically for this project. The Contractor shall calculate and certify that the perimeter roof specialties systems furnished meet the anticipated design pressure as specified in the Detailed Specifications when tested in accordance with SPRI Test Methods RE-2 and RE-3.

B. The forming and assembling of sheet metal components shall be performed using methods that will not void any manufacturer's warranty.

C. Contractor must obtain all components of the roof specialties system from a single manufacturer. Any secondary products that are required which cannot be supplied

by the specified manufacturer must be recommended by the manufacturer and approved by the Engineer.

D. Installer Qualifications:

1. Engage an experienced metal edge system contractor to install edge system who has a minimum of three (3) years of experience specializing in the installation of metal edge systems.

2. Contractor must be certified by manufacturer specified as a supplier of the metal edge system and obtain written certification from manufacturer that installer is approved for installation of the specified system.

E. Coordination:

1. The Contractor will be obligated to coordinate the Work under other Sections to ensure perfect match of colors. The Contractor shall submit samples of each approved manufacturer's finishes for approval.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to:

1. Samples of each material listed

2. Manufacturers Literature

B. Each submittal shall be identified by the Specification Section Number.

C. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed materials compliance with the Contract Documents.

D. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmission.

E. Samples shall include finish and color samples for all items.

F. Shop Drawings shall include, but not be limited to:

1. Complete layout and installation drawings with clearly marked dimensions and schedules including sizes, weights, gages of metal and spacing.

2. Details of all attachments.

G. Design Test Reports:

1. Submit copies of design test reports for each of the performance testing standards listed in Article 1.05 herein.

2. Test reports shall be performed by independent, International Accreditation Service, Inc. (IAS) accredited testing laboratory, and shall bear the seal of a registered Professional Engineer licensed in the State of New York.

H. Engineering Calculations:

1. Submit engineering wind pressure calculations specific to this Project.

2. Calculations shall be prepared and sealed by a registered Professional Engineer licensed in the State of New York, who is a full-time employee of the system manufacturer.

3. Calculations shall clearly demonstrate that the system is capable of resisting the calculated design wind pressure(s) after the application of the safety factor specified herein in accordance with the requirements of ANSI/SPRI ES-1 and the building code.

I. Installer Qualifications:

1. Engage a single installer skilled, trained and with successful experience in the installation of roof specialties systems and with successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of work. Submit names and qualifications to the Engineer for approval along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owners, architects or engineers responsible for projects.

b. Approximate contract cost of the system.

c. Amount of area installed.

J. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

K. The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in factory-packed unopened cartons and crating bearing the manufacturer's labels.

B. Store materials in clean, dry and protected areas in such manner to preclude damage of any nature.

C. Handle all materials with proper care to avoid denting, marring, warping, or other distortions during delivery, storage, and handling.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

B. The Contractor shall furnish to the City a fifteen (15) year written Manufacturer's Warranty covering materials and workmanship for the entire "Coping System", including repair and replacement of components which are deemed faulty or in disrepair during the warranty period. Such items in disrepair shall be repaired at no cost to the City. These guarantees shall cover both labor and materials necessary to effect water tightness, including that required to repair leaks caused by defective material and/or workmanship, without limit as to amount required to effect water tightness

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Copings:
    a. "Permasnap" as manufactured by OMG Roofing Products, Agawam, MA
    b. Or approved equal
2. Roof curbs:
    a. Custom Solutions Roofs and Metal Products, Cedar Rapids, IA.
    b. Or approved equal
3. Fascia and gravel stops:
    a. "Type AP" (gravel stops) and "Type SP" (fascia) as manufactured by Architectural Products Company, Hebron, KY
    b. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Copings:

1. Coping units over parapet walls to be 22 ga., or as noted on the Contract Drawings.
2. Units to be of size and profiles shown on the Contract Drawings.
3. Provide coping units with mitered welded corners, splice plates and joint trim, retainer clips, compression pads, fasteners and other accessories required to make a complete installation, in accordance with the manufacturer's recommendations.
4. Finish on all exposed surfaces of stainless steel copings and accessories to be Type 304-2B.

5. Sealants for installation of copings shall be of an approved type acceptable to the manufacturers of materials herein specified.

6. Fastenings shall be concealed type, stainless steel or cadmium plated. Self-tapping screws to be stainless steel of sizes recommended by the manufacturers.

7. Seed clips to be stainless steel.

B. Roof curbs shall be fabricated of Stainless Steel: 0.028 inch thick with continuous mitered and welded corner seams, integral base plates, factory installed pressure treated wood nailed, and insulated with 1½ inch thick rigid fiberglass insulation. Profile shall be as shown on the Contract Drawings.

1. Type 304-2B.

2. Sealants for installation of copings shall be of an approved type acceptable to the manufacturers of materials herein specified.

3. Fastenings shall be concealed type, stainless steel or cadmium plated. Self-tapping screws to be stainless steel of sizes recommended by the manufacturers.

4. Seed clips to be stainless steel.

C. Roof curbs shall be fabricated of Stainless Steel: 0.028 inch thick with continuous mitered and welded corner seams, integral base plates, and factory-installed pressure treated wood nailed and insulated with 1½ inch thick rigid fiberglass insulation. Profile shall be as shown on the Contract Drawings.

D. Fascia and gravel stops shall be fabricated of 22 ga. Type 304-2B stainless steel 5005-H34 alloy.

E. Fascia and gravel stops shall consist of complete assemblies, composed of hold down clips, joint covers, preformed mitered welded covers and other accessories required for a complete installation in accordance with the manufacturer's recommendation.

F. Manufacturer's Standards: In addition to the standards listed above, the flashing products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination:

1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, system supports, and other conditions affecting performance of the Work.
2. For the record, prepare written report, approved by Installer, listing conditions detrimental to performance of the Work. Any Work needed to correct unsatisfactory conditions need to be submitted to the Engineer for approval prior to the Work being done.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation:

1. Dissimilar metals shall be separated from each other by painting each metal surface in contact with a coating as specified in Section 09 91 00 – Painting.
2. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
3. Establish straight, side and crosswise benchmarks.
4. Use proper size and length fastener for strength requirements.
5. All surfaces shall be checked for square and straightness.
6. Measure the wall lengthwise and crosswise to confirm lengths, widths, and clearances of roof specialties system components and verify clearances for thermal movement.

3.02 INSTALLATION

A. General:

1. Unless otherwise specified, all roof specialties shall be installed in accordance with the manufacturer's instructions to provide a complete watertight and weatherproof construction, free from bends and buckles and as shown on the Contract Drawings. Ample provision shall be made for expansion and contraction. Repair or replace all materials that have been damaged during installation.

B. Sheet Underlayment:

1. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over entire parapet or roof-wall edge, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (150 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 90 days.

C. Copings:

1. Install copings true and straight. Fasten as recommended by manufacturer. Seal and flash in accordance to primary roofing manufacturer's recommendations.

2. Install in manufacturers standard lengths with anchor plates and concealed joint cover at each joint. All screws shall be of stainless steel. Mitered and welded corners shall be used for all changes in direction.

D. Roof Curbs:

1. Center curbs over openings.

2. Anchor to wood blocking installed under Section 06 10 00 - Rough Carpentry.

E. Leave units ready to receive flashing provided herein and to be installed as the membrane roofing is installed.

3.03 FIELD TESTING / QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect roof specialties system installation, including accessories. Report results in writing.

B. Remove and replace applications of roof specialties system where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional Work with specified requirements.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Check levels and adjust as necessary after roofing and flashing is complete.

B. Protect materials from damage by other trades. Remove protective coatings at completion of project as directed by the Engineer.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 07 71 23 – MANUFACTURED GUTTERS AND DOWNSPOUTS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Gutters and downspouts as specified herein include, but are not limited to, prefabricated gutters, downspouts, scuppers, collection boxes, flashing, sealants, and bonding agents between the components of this Section and appurtenances.

B. Gutters and downspouts shall be provided as indicated on the Contract Drawings, specified herein or in the Contract, or as required for a complete installation.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 13.01 -- Galvanizing

B. Section 09 91 00 -- Painting

1.04 REFERENCES

A. ASTM A480 -- Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

B. ASTM A653 -- Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C. ASTM B209 -- Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

D. ASTM B221 -- Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

E. ASTM B370 -- Standard Specification for Copper Sheet and Strip for Building Construction

F. SMACNA -- Sheet Metal and Air Conditioning Contractors National Association, Incorporated, Architectural Sheet Metal Manual

G. SPRI -- Single Ply Roofing Industry, Wind Design Guide for Use with Low Slope Roofing

1.05 DESCRIPTION

A. The products provided by this Section shall include the following:

1. Prefabricated gutters, collection boxes, scuppers, and downspouts formed to profiles, constructed of materials, and installed as shown on the Contract Drawings and specified in the Contract.

2. Accessories and items essential for the completeness of the installation shall be the same kind of material as the item to which they are applied.

3. Materials shall be manufactured and delivered from manufacturing locations that are closest to the Project Site to reduce transportation cost and emissions.

4. Sustainable Design Requirements:

a. Recycled Content of Steel Sheet Metal: Postconsumer recycled content plus one-half of preconsumer recycled content shall not be less than 25 percent.

b. Recycled Content of Aluminum Sheet Metal and Extrusions: Postconsumer recycled content plus one-half of preconsumer recycled content shall not be less than 25 percent.

1.06 QUALITY ASSURANCE

A. The workmanship of sheet metal work, method for forming joints, anchoring, cleating, and provisions for expansion shall conform to the standard details and recommendations of the Copper Development Association and the Architectural Sheet Metal Manual published by SMACNA. Workmanship shall be in accordance with the best trade practice and recommendations and specifications of the Sheet Metal and Air Conditioning Contractors National Association, Incorporated.

1. Uplift requirements shall match the requirements for adjacent membrane roofing as specified in the Contract.

2. Wind resistance calculation shall be designed specifically for this Project. The Contractor shall calculate and certify that the perimeter metal edge systems furnished meet the anticipated design pressure as specified in the Contract when tested in accordance with SPRI Test Methods RE-2 and RE-3.

B. The forming and assembling of sheet metal components shall be performed using methods that will not void any manufacturer’s warranty.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Product Data: The Contractor shall submit

a. Copies of specifications, installation instructions and general recommendations from the gutter and downspout system manufacturer.

b. Manufacturer's data substantiating that the materials comply with the requirements shall be included.

2. Shop Drawings: Shop Drawings shall show layout, profiles, methods of joining, and methods of attachment and anchorage for the gutter and downspout system.

3. Samples: The Contractor shall submit

a. Three 12-inch long samples of factory fabricated products, including the finishes specified herein.

4. Sustainable Design Submittals:

a. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

1) Name of Product and Manufacturer.

2) Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

3) The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. All materials shall be stored in a dry, enclosed area, out of direct sunlight, off the ground and away from all possible contact with water, ice, or snow.

3. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled carefully in order to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be permanently removed from the Site and shall not be incorporated into the Work.

3. Packages or containers shall not be opened until all necessary, preparatory Work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used.

2.02 MATERIALS / EQUIPMENT

A. General: Gutter and downspout system shall be provided by the same manufacturer. Material and profiles of the gutter and downspout system shall be as specified in the Contract Drawings or herein. Specified materials shall meet the following minimum requirements.

B. Aluminum Extrusions: Alloy and temper of aluminum extrusions shall be as recommended by the manufacturer for the use intended, and as required for proper application of finish specified, but not less than the strength and durability properties specified in ASTM B221 for 6063-T6.

C. Aluminum Sheet: Alloy and temper of aluminum sheet be as recommended by the manufacturer for the use intended, and as required for proper application of finish specified, but not less than the strength and durability properties specified in ASTM B209 for 5005-H15.

D. Galvanized sheet metal shall be in accordance with the requirements of ASTM A653 and Section 05 05 13.01 - Galvanizing, and shall be a minimum 20-gauge thickness. Galvanized sheet metal shall be mill phosphatized where shown or specified to be painted.

E. Stainless steel shall be AISI Type 304-2B, in compliance with ASTM A480, and shall be of 22-gauge thickness.

F. Copper shall be in conformance with ASTM B370, minimum 16 oz., and shall have a temper of H00 (cold-rolled) except where temper 060 is required for forming.

G. Gutter and Downspout System: Gutters, downspouts, collection boxes, and/or scuppers shall be factory fabricated to configurations indicated on the Contract Drawings. Gutter straps, support brackets, elbows, fittings, drain bars, and appurtenances shall be factory fabricated for their intended use. Gutters shall be fabricated with expansion joints at a maximum of 48 feet on center. Gutter straps and/or support brackets shall be installed at a minimum of 30 inches on center.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Finishes shall be as specified in the Contract.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall verify that areas to receive gutters and downspouts are properly prepared and completed to final elevations.

B. Preparation

1. Dissimilar metals shall be separated from each other by painting each metal surface in contact with a coating as specified in Section 09 91 00 - Painting.

3.02 INSTALLATION

A. Gutters and downspouts shall be installed in strict accordance with the manufacturer's instructions and recommendations, and in compliance with the SMACNA Architectural Sheet Metal Manual.

B. Gutter and downspout work shall be watertight and weather-tight with all lines, arrises and angles sharp and true. Plain surfaces shall be free from waves and buckles.

C. Outlets and end caps shall be placed where shown on the Contract Drawings, and shall be installed in accordance with the manufacturer's instructions and recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. All components of the Work shall be protected from damage until construction operations are completed and acceptable to Engineer.

2. Work which cannot, for reasons acceptable to Engineer, be completed before the onset of weather detrimental to the Work shall be completely protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.

3. Gutters and downspouts shall be protected from all damage and abuse from all other Contractors and installers involved in the Work until Final Acceptance by DEP.

B. Adjustment

1. System components which are dislodged, damaged, expanded, or penetrated by subsequent installation operations or damaged by detrimental

weather shall be immediately replaced with undamaged material in compliance with the Sections and properly protected as specified.

C. Cleaning

1. Exposed metal surfaces shall be cleaned using materials and processes as recommended by the manufacturer.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 07 72 33.02 – ROADWAY HATCHES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for roadway hatches, custom stainless steel hardware, and accessories for complete watertight systems. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and place into satisfactory operation all roadway hatch work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A.	NYBC	-	New York City Building Code.
B.	ASTM A666	-	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar, Standard Specification for
C.	OSHA 29 CFR 1910.27	-	Occupational Safety and Health Act of 1970, Fixed Ladders

1.05 DESCRIPTION

A. Performance Criteria:

1. Roadway hatch Work shall be permanently watertight and not deteriorate in excess of manufacturers' published limitations.

2. For hatches in the roadway, detail and fabricate hatches to withstand H20 loading and direct traffic including buses, snow plows, and tractor trailers. Specified loadings shall not cause any permanent deflection in the hatch or support curbs or damage to operating hardware. Roadway hatches must remain floodproof under loaded, unloaded, and critical flood conditions.

B. Requirements of Regulatory Agencies:

1. Comply with applicable requirements of the New York City Building Code and the requirements of OSHA 1910.27 for roof hatch minimum sizes, clearances and coordination with fixed ladders.

C. Do not proceed with the roadway hatch work until curb and substrate construction, blocking, and other construction to receive the Work is completed.

D. Schedule the installation of roadway hatch work to coincide with the installation of framing at openings, and other adjoining and substrate work so that the roadway hatches may be built in as the Work progresses as shown on approved Shop Drawings and without the need for field changes to approved installation details in order to maintain permanently water- and weathertight conditions.

E. Proceed with and complete the Work only when materials, equipment, and knowledgeable tradesmen required for the installation of roadway hatches, forming and casting in place are at the Site and are ready to follow.

1.06 QUALITY ASSURANCE

A. Source Quality Control:

1. Obtain materials only from manufacturers who will, if requested, give guidance of proper procedures and precautions during the installation of the roadway hatches.

2. Engage manufacturers who have been successfully providing roadway hatches of the type specified and who will submit a list of successful

installations along with telephone numbers of owners, architects or engineers responsible for the Work.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Copies of manufacturer's proposed fabrication details and material specifications for roadway hatches.

2. Include roughing-in drawings as appropriate to the location of the item.

3. Manufacturer’s specifications, installation and coordination instructions and other data as may be requested by Engineer substantiating that products comply with the requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials without damage and in manufacturer’s original, unopened and undamaged protective wrappings bearing name and model number of approved items.

B. Storage of Materials:

1. Minimize the amount of time roadway hatches are stored on-Site. If roadway hatches do arrive on-Site before they can be incorporated into the orderly assembly of the Work, store in a completely protected and secure enclosure, under cover and away from all other construction traffic.

2. Do not store in contact with earth, wood or concrete or in contact with other surfaces that could cause staining or other types of surface marks or blemishes of any kind.

C. Handling of Materials:

1. Do not subject roadway hatches to bending or stress of any kind.

2. Handle and protect units during installation in a manner recommended by the roadway hatch manufacturer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to the City the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship. For the H20 Roadway Hatch, the warranty shall cover at least 10 years from the date of purchase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. H20 Roadway Hatch:

    a. Model# DT93ZHD as manufactured by U.S. Fabrications, Inc., Hialeah, FL, as Distributed by Acudor Products, Inc

2.02 MATERIALS / EQUIPMENT

A. H20 Roadway Hatch:

1. Single leaf hatch size indicated in sheets.
2. Provide manufacturer's standard units, modified as necessary to comply with the requirements. Custom fabricate units wherever necessary for size, type, and profile, using manufacturer's standard detailing to the extent applicable.
3. The entire assembly shall be designed for zero leak. It must be third party tested and rated to 10 PSI of water pressure bearing in-between the sealed opening (between the cover and frame) for a period of time up to five hours with zero leaks.
4. Materials:

    a. Stainless Steel: Sheet and extrusions of the alloys and tempers specified by the manufacturer for strength, durability and proper application of finish.

        1) Cover: 1/4” diamond plate

        2) Frame: 1/4”. Area of frame that will come in contact with concrete shall be coated with bituminous paint.

        3) Cover Liner: 14 gage

    b. Gaskets: Silicone gasket securely attached in a continuous groove to underside of covers.

    c. Equip units with custom self-lifting mechanism for smooth and easy controlled operation throughout the entire arc motion of opening and closing. Provide custom ASTM A666 Type 316 stainless steel hardware including hold-open devices, compression spring operators enclosed in telescopic tubes, latch, and operating handles for inside operation. Equip units with hardware for manual release operation from outside. All surface hardware must be flood tight, and flush to hatch and frame, so as not to pose a driving hazard. Covers shall close flush with the frame with flood tight Type 316 stainless steel Compression CAM locks. Hold-open devices that require the manual insertion of pins will not be allowed.

d. Hinges: cover integrated 316 stainless-steel hinge lugs and pins with tamperproof features.

e. Hatch shall be designed to be cast-in flush with the surrounding area: products that do not sit flush will not be allowed.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shop-fabricate each unit complete with framing, gaskets, structure, curbs, hardware, accessories, anchorage provisions, and other components. Disassemble only to the extent necessary for delivery and installation.

B. Construct units for live loading specified using manufacturer's custom fabrication details. Reinforce as required with aluminum structural sections to order to provide resistance to the loading specified.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection

1. The Contractor shall examine the substrate and the conditions under which the roadway hatch work is to be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Preparation

1. Clean the substrate of dust, debris, substances, and interferences detrimental to the Work and prepare substrates as recommended by the roadway hatch manufacturer.

3.02 INSTALLATION

A. Separate dissimilar metals from substrates and from each other by painting each metal surface in the area of contact with a 15-mil thick application of bituminous coating, as recommended by the manufacturers of the dissimilar metals.

B. Anchor roadway hatch permanently to the substrate, by approved methods which are adequate for the sizes and locations of units and which shall provide permanent resistance to loading specified.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protect roadway hatch Work until Final Acceptance of the Work by DEP.

B. Do not permit workmen, or others, to step directly on roadway hatches in place, or to place or move equipment over roadway hatch surfaces. Protect surfaces during other adjoining Work.

C. Neutralize excess flux as work progresses with five percent to ten percent washing soda solution and rinse thoroughly.

D. Clean exposed surfaces of every substance which is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces. Exercise extreme care to remove fluxes and ferrous metal particles, including welding splatter and grinding dust.

E. Do not leave metal debris and discarded materials at the site of the Work. Clean each site of the Work as the Work progresses on a daily basis.

END OF SECTION

SECTION 07 72 33 – ROOF HATCHES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for roof hatches, custom stainless steel hardware, and accessories for complete watertight systems. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and place into satisfactory operation all roof hatch work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry

B. Section 07 53 00 - Elastomeric Membrane Roofing

C. Section 07 62 00 - Sheet Metal Flashing and Trim

1.04 REFERENCES

A. NYBC - New York City Building Code.

B. ASTM A666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar, Standard Specification for

C. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for

D. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Standard Specification for

E. AMP/NAAMM AMP 500- Architectural Metal Products Division of the National Association of Architectural Metal Manufacturers, Finishes for Aluminum

F. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Incorporated, Architectural Sheet Metal Manual

G. OSHA 29 CFR 1910.27 - Occupational Safety and Health Act of 1970, Fixed Ladders

1.05 DESCRIPTION

A. Performance Criteria:

1. Roof hatch Work shall be permanently watertight and not deteriorate in excess of manufacturers' published limitations.

2. Detail and fabricate roof hatches to withstand a live load of 40 per square foot over the entire horizontal plane of the hatch and a concurrently acting point load of 200 pounds located at the center of the roof hatch. Specified loadings shall not cause any permanent deflections in the roof hatch or support curbs or damage to operating hardware.

B. Requirements of Regulatory Agencies:

1. Comply with applicable requirements of the New York City Building Code, SMACNA Sheet Metal Manual details and the requirements of OSHA 1910.27 for roof hatch minimum sizes, clearances and coordination with fixed ladders.

C. Do not proceed with the roof hatch work until curb and substrate construction, blocking, and other construction to receive the Work is completed.

D. Coordinate the installation of roof hatch work with roofing and flashing work in order to provide continuity in the installation of roofing Work in a manner which maintains roofing manufacturer's guaranteed construction.

E. Schedule the installation of roof hatch work to coincide with the installation of roofing, drains, piping, blocking, nailers, framing at openings, curbs, and other adjoining and substrate work so that the roof hatches may be built into the Elastomeric Membrane Roofing as the Work progresses as shown on approved Shop Drawings and without the need for field changes to approved installation details or methods of flashing in order to maintain permanently water- and weathertight conditions on the roof.

F. Proceed with and complete the Work only when materials, equipment, and knowledgeable tradesmen required for the installation of roof hatches, flashing, and trim systems are at the Site and are ready to follow and integrate the Work of this Section with Work requiring the installation of sheet metal flashing and trim and Elastomeric Membrane Roofing.

1.06 QUALITY ASSURANCE

A. Source Quality Control:

1. Obtain materials only from manufacturers who will, if requested, send a qualified technical representative to the Site for the purpose of advising installer of proper procedures and precautions during the installation of the roof hatches.

2. Engage manufacturers who have been successfully providing roof hatches of the specified type and who will submit a list of successful installations along with telephone numbers of owners, architects, or engineers responsible for the Work.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Copies of manufacturer's proposed fabrication details and material specifications for roof hatches.

2. Include flashing and roughing-in drawings showing this work coordinated with Sections 07 53 00 - Elastomeric Membrane Roofing, 06 10 00 - Rough Carpentry and 07 62 00 - Sheet Metal Flashing and Trim as appropriate to the location of the item.

3. Manufacturer’s specifications, installation and coordination instructions, and other data as may be requested by Engineer substantiating that products comply with the requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials without damage and in manufacturer’s original, unopened and undamaged protective wrappings bearing name and model number of approved items.

B. Storage of Materials:

1. Minimize the amount of time roof hatches are stored on-Site. If roof hatches do arrive on-Site before they can be incorporated into the orderly assembly of the roofing work, store in a completely protected and secure enclosure, under cover and away from all other construction traffic.
2. Do not store in contact with earth, wood or concrete or in contact with other surfaces that could cause staining or other types of surface marks or blemishes of any kind.

C. Handling of Materials:

1. Do not subject roof hatches to bending or stress of any kind.
2. Handle and protect units during installation in a manner recommended by the roof hatch manufacturer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Ladder Access Roof Hatch: Provide one of the following:
   a. Type S with Ladder up Safety Post as manufactured by Bilco Company, Zanesville, OH;
   b. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Stair Access Roof Hatch:

1. Provide manufacturer's standard units, modified as necessary to comply with the requirements. Custom fabricate units wherever necessary for size, type and profile, using manufacturer's standard detailing to the extent applicable.
2. Materials:
   a. Aluminum: Sheet and extrusions of the alloys and tempers specified by the manufacturer for strength, durability and proper application of finish.
      1) Cover and Curb: 11 gage; ASTM B221 and ASTM B209, 6063-T5 alloy.

2) Cover and Curb Liner: 14 gage; ASTM B221 and ASTM B209, 3003-H-14 alloy.

3) Finish: Class I high density clear anodized coating, AMP 500 Aluminum Association Designation A41.

b. Insulation: 1-inch glass fiber, between aluminum panels.

c. Gaskets: Fingered design; polyvinylchloride.

d. Equip units with custom self-lifting mechanism. Provide custom ASTM A666 stainless steel hardware including hold-open devices, hinges, compression spring operators enclosed in telescopic tubes, latch, and operating handles for inside operation. Equip units with hardware for manual release operation from outside.

3. Size: 2 foot-0 inches by 8 foot-0 inches

B. Ladder Access Roof Hatch:

1. Provide manufacturer's standard units, modified as necessary to comply with the requirements. Custom fabricate units wherever necessary for size, type, and profile, using manufacturer's standard detailing to the extent applicable.

2. Materials:

a. Aluminum: Sheet and extrusions of the alloys and tempers specified by the manufacturer for strength, durability and proper application of finish.

1) Cover and Curb: 11 gage; ASTM B221 and ASTM B209, 6063-T5 alloy

2) Cover and Curb Liner: 14 gage; ASTM B221 and ASTM B209, 3003-H-14 alloy

3) Finish: Class I high density clear anodized coating, AMP 500 Aluminum Association Designation A41

b. Insulation: 1-inch glass fiber, between aluminum panels

c. Gaskets: Fingered design; polyvinylchloride

d. Equip units with custom self-lifting mechanism. Provide custom ASTM A666 stainless steel hardware including hold-open devices, hinges, compression spring operators enclosed in telescopic tubes, latch, and operating handles for inside operation. Equip units with hardware for manual release operation from outside.

3. Provide manufacturer’s recommended operable steel safety posts mounted at center of roof ladder rungs.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shop-fabricate each unit complete with framing, gaskets, structure, curbs, flashing, well-liners, hardware, accessories, anchorage provisions, and other components. Disassemble only to the extent necessary for delivery and installation.

B. Construct units for live loading specified using manufacturer's custom fabrication details. Reinforce as required with aluminum structural sections to order to provide resistance to the loading specified.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection

1. The Contractor shall examine the substrate and the conditions under which the roof hatch work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Preparation

1. Clean the substrate of dust, debris, substances and interferences detrimental to the Work and prepare substrates as recommended by the roof hatch manufacturer.

3.02 INSTALLATION

A. Separate dissimilar metals from substrates and from each other by painting each metal surface in the area of contact with a 15-mil thick application of bituminous coating, as recommended by the manufacturers of the dissimilar metals.

B. Bed flanges of set-on accessories in a compound which is compatible with roofing and flashing and which is acceptable to, and consistent with, material and detailing requirements of the manufacturer of roofing for guaranteed construction. On sloping decks, flash flanges with other Work for proper water shed.

C. Anchor roof hatch permanently to the substrate, by approved methods which are adequate for the sizes and locations of units and which shall provide permanent resistance to loading specified.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protect roof hatch work until Final Acceptance of the work by DEP.

B. Do not permit workmen, or others, to step directly on roof hatches in place, or to place or move equipment over roof hatch surfaces. Protect surfaces during installation of Elastomeric Membrane Roofing, sheet metal flashing work and other adjoining Work.

C. Neutralize excess flux as work progresses with five percent to ten percent washing soda solution and rinse thoroughly.

D. Clean exposed surfaces of every substance which is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces. Exercise extreme care to remove fluxes and ferrous metal particles, including welding splatter and grinding dust.

E. Do not leave metal debris and discarded materials at the Site of the Work. Clean each site of the Work as the Work progresses on a daily basis.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install firestopping products, systems, and installation with UL listing and/or factory-certified Engineering Judgements, as required by the NYC Building Code and as specified herein.

B. Firestopping shall include the following:

1. Penetrations through fire resistance rated floor, walls, and roof construction including both empty openings and openings containing cables, conduits, and other penetrating items furnished under this Contract.

2. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items furnished under this Contract.

3. Sealant joints in fire resistance rated construction, including gypsum drywall partitions and masonry walls.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools And Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination/Preparation	8
3.02	InstalLation	9
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleaning	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 43 10 – Quality Assurance Inspection

C. Section 01 65 00 – Product Delivery Requirements

D. Section 26 05 14 – Medium-Voltage Cables and Accessories

E. Section 26 05 20 – Low-Voltage Wires, Cables and Accessories

F. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.04 REFERENCES

A. ASTM International (formerly American Society for Testing and Materials)

1. ASTM E84 -19b Standard Test Method for Surface Burning Characteristics of Building Materials

2. ASTM E-119-19 Standard Test Methods for Fire Tests of Building Construction and Materials

3. ASTM C 569 Test Method for Indentation Hardness of Preformed Thermal Insulations

4. ASTM C 665, Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

5. ASTM E814-13a(2017) Standard Test Method for Fire Tests of Penetration Firestop Systems

6. ASTM E2174-19 Standard Practice for On-Site Inspection of Installed Firestops

B. Underwriters Laboratories (UL)

1. UL 263 Fire Tests of Building Construction and Materials

2. UL 723 Surface Burning Characteristics of Building Materials

3. UL 1479 Standard for Fire Tests of Penetration Firestops

4. UL 2079 Standard for Tests for Fire Resistance of Building Joint Systems

C. U.S. Government, Code of Federal Regulations (CFR), Title 40 Protection of Environment

1. 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy".

1.05 DESCRIPTION

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

B. F-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with F-ratings indicated, as determined per ASTM E814-13a and UL 1479, but not less than that equaling or exceeding the fire resistance rating of the constructions penetrated.

C. T-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with T-ratings, in addition to F ratings, as determined per ASTM E814-13a and UL 1479, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-ratings shall be per code but not less than one hour. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.

2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.

3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature rise rating.

4. Where firestop systems protect penetrating items larger than a four inch diameter nominal pipe or 16 square inches in overall cross sectional area.

D. Fire Resistive Joint Sealants: Provide joint sealants with fire resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.

E. For Firestopping Exposed to View, Traffic, Moisture, and Physical Damage, Provide Products That Do Not Deteriorate When Exposed to These Conditions:

1. For piping penetrations for plumbing and wet-pipe systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetration with annular spaces exceeding four inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F. For firestopping exposed to view, provide products with flame spread values of less than 25 and smoke developed values of less than 450, as determined per ASTM E 84.

G. Firestopping shall be provided for, but not limited to, the following:

1. Raceways such as conduits, wireways, bus ducts, cable busses and cable trays provided in Section 26 05 33 - Raceways and Boxes for Electrical Systems.

2. Medium-voltage and low-voltage wires, cables and accessories provided in Section 26 05 14 – Medium-Voltage Cables and Accessories and Section 26 05 20 – Low-Voltage Wires, Cables and Accessories.

3. Pipes, tubing, ducts, and other devices provided in all other divisions of the Contract Sections.

1.06 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the “System Performance Requirements” article:

1. Firestopping tests are performed by UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per ASTM E 814.

3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119-19.

B. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design, and extent to that indicated for Project and that has performed successfully.

C. Single Source Responsibility: Obtain through penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.

D. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

E. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through penetration firestop systems are installed per specified requirements.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section "Project Meetings."

G. Field Testing of firestop systems shall be performed for each type of firestop systems.

H. Inspection of installed firestop systems shall be conform to ASTM E2174-19.

1.07 SUBMITTALS

A. The Contractor shall submit the following in accordance with the requirements of the Section 01 33 00 – Submittal Procedures.

1. Product Data: Submit manufacturer's literature for each type of Firestop material to be installed. Indicate product characteristics, typical uses, performance and limitation criteria, and test data.

2. Shop Drawings: Show typical installation details for the methods of installation. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

   a. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from a similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgment shall follow the requirements set forth by the International Firestop Council.

3. Certificates: Submit certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.

4. Installation Instructions: Submit manufacture's installation procedures for each type of product.

5. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.

6. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number and shelf life.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.09 SPARE PARTS, SPECIAL TOOLS AND SUPPLIES

A. Not Used.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 3M Fire Protection Products, St. Paul, MN.

B. Hilti, Inc., Tulsa, OK.

C. Specified Technologies Inc. (STI), Somerville, NJ.

D. Bio Fireshield, Carlisle, MA.

E. W.R Grace, Flamesafe.

F. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire-resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

1. Provide paintable firestop products at locations exposed to the public. Mechanical and electrical rooms are not considered public spaces.

B. Compatibility: Provide through-penetrations firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for

firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including, but not limited to, the following:
    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/ damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Firestop Mortar:
1. Specified Technologies Inc. SpecSeal Mortar.
2. Bio Fireshield Novasit K-10.
3. Hilti FS 635 Trowelable Firestop Compound.
4. Or approved equal.

B. Firestop Sealants and Caulks:
1. STI SpecSeal Sealant.
2. Dow Corning Firestop Sealant No. 2000.
3. 3M CP25WB + Caulk.
4. Bio Fireshield Biotherm and Biostop.
5. Hilti FS-ONE High Performance Intumesent Firestop Sealant.
6. Or approved equal.

C. Firestop Putty:
1. STI Spec-Seal Firestop Putty Bars and Pads.
2. 3M MPS-2 Moldable Putty Stix and Putty Pads.

3. Hilti CP 617 and CP 618 Putty Pads and Putty Sticks.

4. Or approved equal.

D. Firestop Collars:

1. STI SpecSeal Firestop Collars.

2. 3M PPD Collars.

3. B10 Fireshield Bio Firestop Sleeve.

4. Hilti CP 643 and CP 642 Firestop Collars.

5. Or approved equal.

E. Wrap Strips:

1. SpecSeal Wrap Strip.

2. 3M FS-195 Wrap Strip.

3. Hilti CP 645 Firestop Wrap Strips.

4. Or approved equal.

F. Cast-In-Place Firestop Device:

1. Hilti CP 680 Cast-In-Place Firestop Device.

2. Or approved equal.

G. Accessories: Provide forming/damming materials - mineral fiberboard or other type recommended by manufacturer.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION/PREPARATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

C. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.02 INSTALLATION

A. General: Comply with the "Design Requirements" article in Part 1 and the through penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

C. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

D. Coordinate the work of this Section as required with the work of other trades.

E. Coordinate construction of openings and penetrating items to ensure that firestopping systems are installed according to specified requirements.

F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

G. Do not cover up those firestopping installations that will become concealed behind other construction until City’s inspection agency and authorities having jurisdiction, if required, have examined each installation.

1. Notify the City’s inspecting agency at least seven days in advance of through-penetration firestop system installations. Confirm dates and times on days preceding each series of installations.

H. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce

the cross sectional shapes and depths required to achieve fire ratings of designated through penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

I. Install Fill Materials for Through Penetration Firestop Systems by Proven Techniques to Produce the Following Results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.03 FIELD TESTING / QUALITY CONTROL

A. Provide qualified inspection of installed firestops in accordance with ASTM E2174-19.

B. Allow for three random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.

C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for caulking and sealant systems for openings and joints in building roofs and walls between concrete-in-place, masonry units, metal roof flashing, and other equipment and structures in order to provide a positive barrier against the passage of air and moisture.

B. Complete technical services from the approved caulking and sealant manufacturers and on-Site technical representation by their Technical Representatives during the time of delivery, storage, and installation of the Work of this Section and during other Work which may affect the Work of this Section as specified herein is also included.

C. The Contractor shall provide all labor, materials, equipment, and incidentals necessary to perform the Work of this Section as shown on the Contract Drawings, specified herein or required otherwise for a complete job.

D. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used.

1.04 REFERENCES

A. NYCBC -- New York City Building Code

B. ASTM C510 -- Staining and Color Change of Single or Multi component Joint Sealers, Standard Test Method for

C. ASTM C661 -- Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer, Standard Test Method for

D. ASTM C793 -- Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants, Standard Test Method for

E. ASTM C794 -- Adhesion-in-Peel of Elastomeric Joints Sealants, Standard Test Method for

F. ASTM C920 -- Elastomeric Joint Sealants, Standard Specification for

G. ASTM C1247 – Durability of Sealants Exposed To Continuous Immersion In Liquids, Standard Test Method for

1.05 DESCRIPTION

A. System Design Requirements

1. The caulking and sealant systems to be furnished under the Work of this Section shall include two-part elastomeric sealants, components, accessories, and miscellaneous materials used for sealing joints in horizontal and vertical planes.

2. The Work shall include but is not limited to:

a. All joints between cast-in-place concrete and masonry;

b. All cast-in-place concrete to cast-in-place concrete expansion joints;

c. All joints between masonry and metal;

d. All control joints in masonry and concrete;

e. All isolation joints between equipment and other items; and

f. Joints were construction systems are discontinuous or inherently non-watertight.

3. The Work shall be performed at all locations, whether or not indicated, required to render the building watertight except where a construction system

is specifically specified or shown as not relying upon the use of sealants in order to achieve weather- and water tightness.

4. Fire Rating:

a. Where caulking and sealant systems are applied within a fire rated room, corridor, egress path, and as indicated in the Contract Drawings, those caulking and sealant systems shall maintain the fire rating of the location in which application is being done.

B. Substitutions

1. Do not change products, system components, colors, or manufacturers after Shop Drawing and Samples approvals by Engineer.

2. Clearly identify, in a manner which is highlighted to the Engineer, all proposed substitutions, modifications, variations, unspecified features, and "or equal" products. Provide complete comparative data with specified products at time of Shop Drawing submission.

C. Sustainable Design Requirements

1. Low Emitting Materials: Sealants and sealant primers used on Site and within the building's weatherproofing system shall comply with the following limits for VOC content:

a. Architectural Sealants: 250 g/L.

b. Sealant Primers for Nonporous Substrates: 250 g/L.

c. Sealant Primers for Porous Substrates: 775 g/L.

1.06 QUALITY ASSURANCE

1. Engage a single manufacturer who shall provide the services of a Technical Representative who shall assist Contractor and Engineer by providing technical opinions on the adequacy of materials and methods of installation based on Shop Drawings approved by Engineer.

a. Provide such services during the time of delivery, storage, handling, and installation of all caulking and sealant system components.

2. Test caulking and sealants for compatibility with the substrates specified for conformance to current industry standards and recommend remedial procedures as required.

B. Installer Qualifications: Engage a single installer skilled, trained, and with successful experience in the application of the types of material required, and who agrees to employ only tradesmen with specific skill and successful experience in this type of work.

C. Performance Criteria: Do not provide exposed caulking and sealant work for metal batten roofing, sheet metal flashing and trim or custom preformed metal siding work in order to render the Work watertight. These construction systems shall be detailed, fabricated, and provided such that they are inherently watertight without

the use of additional caulking, sealant, elastomeric compounds, asphaltic compounds, or other similar materials.

D. Compatibility: Before purchase of each specified sealant, investigate its compatibility with the joint surfaces, joint fillers, and other materials in the joint system. Provide only materials (manufacturer's recommended variation of the specified materials) which are known to be fully compatible with the actual installation condition, as shown by manufacturer's published data or certification.

1.07 SUBMITTALS

A. The Contractor shall submit the following to the Engineer for review and approval.

1. Samples:

a. Actual cured material samples of each type of caulking and sealant specified, four-inches long, in each of the manufacturer's standard colors.

b. Samples will be reviewed by Engineer for color and texture only.

c. Compliance with other requirements is the responsibility of Contractor.

B. Shop Drawings:

1. Copies of manufacturer's specifications, recommendations and installation instructions for each type of sealant, caulking compound and associated miscellaneous material required. Include manufacturer's published data, indicating that each material complies with the requirements and is intended for the applications shown.

2. Test Reports:

a. Compatibility tests for substrates, based on adhesion-in-peel standard test procedures and ASTM C920.

b. Copies of certified laboratory test reports indicating conformance with the requirements specified.

3. Guarantee:

a. Copies of written guarantee agreeing to repair or replace sealants which fail to perform as specified.

4. Sustainable Design Submittals:

a. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

1) Name of Product and Manufacturer.

2) Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

3) The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

5. VOC Reporting Form.

a. For all sealants and sealant primers used on site and within the building's weatherproofing system, provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver materials in caulking and sealant manufacturer's original unopened and undamaged containers, with information accurately representing container contents as approved by Engineer at time of Shop Drawing and Samples submissions.

2. Include the following information on the label:

a. Name of material and supplier.

b. Formula or specification number, lot number, color, and date of manufactures.

c. Mixing instructions, shelf life, and curing time when applicable.

3. Failure to comply with these requirements shall be sufficient cause for rejection of the material in question, by the Engineer, and his requiring its removal from the Site. Supply new material conforming to the specified requirements at no additional expense to DEP.

B. Storage of Materials:

1. Store materials so as to preclude foreign materials.

2. Do not store or expose materials to temperature above 90 degrees Fahrenheit or store in direct sunshine.

3. Do not use materials which are outdated as indicated by shelf life.

4. Store sealant tape in a manner which will not deform the tape.

5. In cool or cold weather, store containers where temperature approximates 75 degrees Fahrenheit for 16 hours before using.

6. When high temperatures prevail store mixed sealants in a cool place.

C. Handling:

1. Handle materials carefully to prevent inclusion of foreign materials.

2. Do not open containers or mix components until necessary preparatory work and priming has been completed.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior and Interior Joints in Vertical Planes: Provide one of the following:

1. Dymeric 240FC as manufactured by Tremco Incorporated, an RPM Company, Beachwood, OH.
2. Sikaflex-2C NS as manufactured by Sika Corporation, Lindhurst, NJ.
3. Or approved equal.

B. Exterior and Interior Joints in Horizontal Planes: Provide one of the following:

1. THC 900/ 901 as manufactured by Tremco Incorporated, an RPM Company, Beachwood, OH.
2. Sikaflex-2C SL as manufactured by Sika Corporation, Lindhurst, NJ.
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Exterior and Interior Joints in Vertical Planes:

1. Urethane-based, two-component elastomeric sealant complying with the following:
    a. ASTM C 920 Adhesion-in-Peel, ASTM C 920and ASTM C794: Minimum 10 lbs/linear inch with no adhesion failure.
    b. Hardness (Standard Conditions), ASTM C661: 20-25 (Shore A).
    c. Stain and color change, ASTM C 920 and ASTM C510: No discoloration or stain.
    d. Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weather meter.
    e. Rheological Vertical Displacement at 120 F, ASTM C 920: No sag.

B. Exterior and Interior Joints in Horizontal Planes:

1. Polyurethane-based, two-component elastomeric sealant complying with the following:
    a. ASTM C 920Water Immersion Bond, ASTM C1247: Elongation of 25% with no adhesive failure.
    b. Hardness (Standard Conditions), ASTM C661: 30-40.

c. Stain and Color Change, ASTM C1247 and ASTM C510: No discoloration or stain.

d. Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weather meter.

C. Provide colors selected by Engineer from caulking and sealant manufacturer's standard color charts. Engineer will select a maximum of ten colors for the Work. Manufacturers supplying sealants other than those specified above must provide the same colors available from those specified.

D. Miscellaneous Materials:

1. Joint Cleaner: Provide the type of joint cleaning compound recommended by the sealant and caulking manufacturer, for the joint surfaces to be cleaned.

2. Joint Primer and Sealer: Provide the type of joint primer and sealer recommended by the caulking and sealant manufacturer, for the joint surfaces to be primed or sealed.

3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended by the caulking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of caulking and sealant. Provide self-adhesive tape wherever applicable.

4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non absorptive material as recommended for compatibility with caulking and sealant by the caulking and sealant manufacturer. Provide size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.

5. Low Temperature Catalyst: Provide the type recommended by the caulking and sealant manufacturer.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Mixing

1. Comply with sealant manufacturer's written instructions for mixing two-component sealants.

2. Thoroughly mix components before use.

3. Add entire contents of activator can to base containers. Do not mix partial units.

4. Mix contents for a minimum of five minutes or as recommended by the sealant manufacturer, until color and consistency are uniform.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall examine the joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and the conditions under which the caulking and sealant work is to be performed, and notify Engineer in writing of any condition detrimental to the proper and timely completion of the Work and the performance of the sealant systems. Do not proceed with the caulking and sealant work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Joint Surface Preparation

1. Clean joint surfaces immediately before installation of sealant compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bonds of sealant compound as recommended by sealant manufacturer's written instructions.

2. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's written instructions indicate that alkalinity does not interfere with sealant bond and performance.

a. Etch with five percent solution of muriatic acid.

b. Neutralize with dilute ammonia solution.

c. Rinse thoroughly with water and allow to dry before sealant installation.

3. If necessary, clean porous materials such as concrete and masonry by grinding, abrasive blasting, or mechanical abrading. Blow out joints with oil-free compressed air, or by vacuuming joints prior to application of primer or sealant.

4. Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or wool to produce a dull sheen.

3.02 INSTALLATION

A. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

B. Prime or seal the joint surfaces wherever recommended by the sealant manufacturer. Do not allow prime or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to application of sealants.

C. Apply masking tape before installation of primer, in continuous strips in alignment with the joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.

D. Do not install sealants without backer rods or bond breaker tape.

E. Roll the back-up rod stock into the joint to avoid lengthwise stretching. Do not twist, braid, puncture or prime backer-rods.

F. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

G. Install sealants to depths as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead.

1. For horizontal joints in sidewalks, pavements and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.

2. For vertical joints subjected to normal movement and sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.

A. Project Conditions / Environmental Conditions:

1. Do not proceed with installation of caulking and sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

2. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength.

3. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.

4. When high temperatures prevail avoid mixing sealants in direct sunlight.

B. Remove excess and spillage of compounds promptly as the Work progresses.

C. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

3.03 FIELD TESTING / QUALITY CONTROL

A. Where questions of compatibility of sealants and substrate arise the sealant manufacturer shall test the substrate in question for compatibility with the specified sealant and report his findings, with recommendations, to Engineer. Any required sealant change shall be at no additional expense to DEP.

B. Do not proceed with installation of elastomeric sealants over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with Paragraph 4.3.9 of ASTM C 920 has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed, or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

C. After nominal cure of exterior joint sealants which are exposed to the weather, test for water leaks. Flood the joint exposure with water directed from a 3/4-inch garden hose, without nozzle, held perpendicular to wall face, 2 feet-0 inch from joint and connected to a water system with 30 pounds per square inch minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.

D. Test approximately five percent of total joint system, in locations which are typical of every joint condition, and which can be inspected easily for leakage on opposite face. Conduct test in the presence of Engineer, who will determine the actual percentage of joints to be tested and the actual period of exposure to water from the hose, based upon the extent of observed leakage, or lack thereof.

E. Where nature of observed leakage indicates the possibility of inadequate joint bond strength, Engineer may direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures and returned to the lowest range of temperature in which it is feasible to conduct testing. Perform testing as directed at any time within 24 months of installation date.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection: Do not allow caulking and sealants to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or the caulking and sealant materials.

B. Repair sealant installation at leaks or, if leakage is excessive, replace sealant installation as directed.

C. Clean adjacent surfaces of sealant or soiling resulting from the Work. Use solvent or cleaning agent recommended by the sealant manufacturer. Leave all finish work in a neat clean condition.

D. Protect the sealants during the construction period so that they will be without deterioration, soiling, or damage at the time of DEP's Final Acceptance.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 08 11 19 – STAINLESS-STEEL DOORS AND FRAMES
CONTRACTPS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install all doors, frames, transoms, sidelights, and associated equipment shown on the Contract Drawings and specified herein.

B. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 08 71 01 - Finish Door Hardware

B. Section 08 81 03 - Glass Plastic and Glazing

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1.	ANSI/SDI A250.8	-	Steel Door Institute, Recommended Specification for Standard Steel Doors and Frames.
2.	ISO 14025	-	Environmental labels and declarations - Type III environmental declarations
3.	NFPA 80	-	National Fire Protection Association, Standard For Fire Doors and Other Opening Protectives
4.	NFPA 105	-	National Fire Protection Association, Standard For the Installation of Smoke Door Assemblies and Other Opening Protectives
5.	NFPA 252	-	National Fire Protection Association, Standard Methods of Fire Tests of Door Assemblies
6.	UL 10B	-	Underwriters Laboratories, Fire Tests of Door Assemblies
7.	UL 10C	-	Underwriters Laboratories, Positive Pressure Fire Tests of Door Assemblies

1.05 DESCRIPTION

A. The Contractor shall be responsible for coordinating all work in this Section with work covered under Section 08 71 01 - Finish Door Hardware.

B. Sustainable Design Requirements

1. Recycled Content of Aluminum Doors and Frames: Postconsumer recycled content plus one-half of pre-consumer recycled content shall not be less than 30 percent.

2. Low Emitting Materials: Paints, coatings, sealants, and adhesives used on site and within the building's weatherproofing system shall meet the VOC content limits listed below.

1.06 QUALITY ASSURANCE

A. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved Shop Drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples if deemed necessary, inspecting welds, verifying dimensions, and finishing inspections.

B. Provide stainless steel doors and frames and accessories manufactured by a single firm specializing in the production of this type of Work and complying with specified standards of ANSI, NFPA, SDI and UL.

C. Materials and Equipment Compliance:

1. Materials and equipment submitted for DEP's approval by the Contractor shall have met, at the time of their submittal, the certification and material acceptance requirements of the NYC Department of Buildings, unless otherwise required by the Authority Having Jurisdiction over the Work.

2. All materials provided under this Section shall comply with the Contract Documents.

3. Comply with all applicable requirements of governing authorities and codes for all work.

D. Fire rated Assemblies: Wherever fire-resistance classification is shown or scheduled for stainless steel doors and frames (3-hour, 1-1/2-hour, and similar designations), provide fire-rated assemblies which are investigated and tested as complete assemblies including the type of fire door hardware to be used. Identify each fire door, frame, and stick system assembly with recognized testing laboratory labels, indicating the applicable fire rating of the door, frame, and stick assembly.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to the following:

1. Samples.

2. Shop Drawings.

B. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed materials compliance with the Contract Documents.

C. Samples shall include:

1. Corner sections of frames and trim.

2. Cut-away corner sections of hollow metal doors showing internal reinforcement specified.

3. Insulating material.

D. Shop Drawings shall include, but not be limited to:

1. Complete layout and installation drawings and schedules with clearly marked dimensions. Drawings shall indicate details of construction, profiles, gauges, reinforcing, and location of all doors and frames.

E. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor Shop Drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

3. VOC Reporting Form. Provide the following information:

a. For all paints, coatings, sealants and adhesives used on site and within the building's weatherproofing system provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged packaging with manufacturer's labels and seals intact.

2. All materials shall be stored in a dry, enclosed area, off the ground and away from all possible contact with water, ice, or snow.

3. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

4. Protection shall be arranged to protect all hardware which may be attached.

C. Handling of Materials:

1. Materials shall be handled carefully in order to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work.

3. Packages shall not be opened until all necessary preparatory work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Door Component Inc., North Plainfield, NJ;

B. Medallion Entry Systems, Inc., Indianapolis, IN;

C. Steelcraft, Cincinnati, OH

D. Or an approved equal.

2.02 MATERIALS / EQUIPMENT

A. Stainless Steel Doors

1. Doors shall be of the finest commercial quality No. 16 gauge Type 316 stainless steel, 1-3/4-inch thick, of sizes shown. Doors shall be series "CH" Seamless Honeycomb Core doors.

2. Finish of all doors and frames shall be #4 finish.

3. All doors shall be provided with stainless steel tags, 1/2-inch diameter x 1/16-inch thick, stamped with the door number and black Japan-filled; numbers shall conform to those in the Door Schedule.

4. Doors shall have a one-piece Kraft honeycomb core securely bonded under heat and pressure to both face sheets. Honeycomb core shall have a one

inch hexagonal cell impregnated with phenolic resin. There shall be no seams on the faces or edges of the doors. Vertical edges shall be continuously heliarc welded, full height of the door. Exterior doors shall be capped to prevent moisture penetrating the door.

5. Double doors shall have applied stainless steel astragals, 1/8-inch x 1- 1/2-inch.

6. Heads and jambs of frames shall be matched, mitered, welded, and finished to present a smooth surface for finishing. Provide a minimum of three anchors per jamb, as well as clip angles for floor anchorage. Prepare frames for all hardware at factory from templates furnished. All hardware cutouts shall be reinforced with 1/8-inch plate welded to frame; 3/16-inch plate shall be used for hinge reinforcements.

7. Jambs shall be constructed to be set on the finished floor. Rubber mutes shall be shipped attached to lock jambs on single doors and on head members for double doors.

8. Glass for all doors shall be secured with moldings of No. 20 gauge stainless steel fastened with stainless steel counter-sunk oval head machine screws. The moldings shall be assembled as frames with corners welded.

9. All exterior doors shall be fully weather-stripped, as called for under Section 08 71 01 - Finish Door Hardware.

10. Louvers in fireproof doors shall be constructed of No. 18 gauge stainless steel and shall be equipped with a fusible link and automatic mechanism as approved by the New York City Building Department Office of Technical Certification and Research (OTCR) and finished to match face of the door.

11. Proper concealed reinforcements of sheet or bar steel shall be provided for hardware and for all attached Work. Reinforcement for butt side of doors shall be a continuous 3/16-inch stainless steel plate. Lock reinforcement shall be No. 12 gauge stainless steel sheet. Reinforcement for door closures, holders, checks and brackets shall be No. 12 gauge plate of length as required for finish hardware.

12. Reinforce tops and bottoms of door with minimum No. 16 gauge horizontal stainless steel closing channels, as integral part of door construction, welded continuously to the outer sheets. Close top and bottom edges to provide weather seal, using 16 gauge flush-mounted inverted closure channels continuously adhered to face sheets with structural silicone adhesive.

13. Edge profiles shall be provided on both stiles of doors beveled 1/8 inch in 2 inches.

B. Stainless Steel Frames

1. Materials shall be free from defects impairing strength anddurability, and/or pressed as required for their respective functions. Molded work shall have sharply defined profiles, and arises shall be clean and sharp. Work shall be

of proper dimensions to receive Work of others. The indicated and specified thicknesses of the metal are minimums.

2. Gauges for steel used in the work shall be as follows:

	STEEL WORK	U.S. GAUGE
1	Combination Metal Frames and Trim:	
	a. Exterior Combination Frames & Trim	No. 12
	b. Interior Combination Frames & Trim	No. 16
	c. Interior Combination Frames & Trim for Fire Rated Frames	No. 14
	d. Exterior Scribe Molding	No. 14
	e. Interior Scribe Molding	No. 18
	f. Exterior and Interior Angle Floor Knees, Adjustable Anchors, Slides and Adjustable Anchors	No. 16
	g. Fillers	As Required
2	Hardware Reinforcement:	
	a. Butts, Checks, Overhead Door Holders, Bracking Pulls	3/16" thick
	b. Locking Latches	No. 12
3	Trim	No. 16

C. Stainless Steel Combination Frames and Trim

1. Stainless steel combination frames and trim shall be placed at door openings, as shown on the Contract Drawings.

2. Stainless steel combination frames and trim shall be of size and approximate design shown on the Contract Drawings, have integrally molded trim and loose molds according to contours of details, be reinforced, and be drilled tapped for hardware. The type, as detailed, covers the general run of frames for the Work but the forming shall be varied from that shown where indicated by special details or necessitated by other conditions.

3. Miter corners accurately, heliarc weld, and dress exposed joints to render the same inconspicuous. Spreaders shall be of an approved type.

4. Frames shall extend to rough concrete slab, bottoms provided with suitable angle clips for securing to jambs. Heads of frames for openings wider than three feet shall be reinforced with angles or channels formed of No. 10

gauge stainless steel spot welded. Where waterproofing occurs, frames shall extend one inch below finished floor. Where required to receive labeled ratings, frames shall be fabricated of gauges required and shall be provided with the necessary labels.

a. Provide stainless steel labels permanently attached to section of frame concealed by closed door.

5. Slots shall be provided at upper sections of vertical members for securing temporary wood blocking to which shall be nailed the braces for holding jambs in place while building walls. All doors frames shall be provided with rubber door silencers, not less than two (2) per jamb.

6. Rubber door silencers shall be shipped attached to lock jamb on single doors and on head members for double doors.

7. Provide holes as approved for fastening wood blocking and trim where such are required by the Contract Drawings.

8. Finish for stainless steel frames shall be No. 4 Finish.

D. Anchors for Stainless Steel Frames

1. Door frames in concrete openings shall be anchored with four hex head stainless steel expansion bolts for each jamb and two hex head stainless steel expansion bolts for each head; where steel lintels occur, machine bolts shall be used. Removable stops shall be installed to cover the bolt heads, the stops to be fastened with counter sunk oval head screws.

2. Door frames in brick or hollow tile openings shall have adjustable anchors spaced 12 inches from the top and bottom of rough bucks and intermediate anchors shall be spaced not more than 30 inches apart on each side. Anchors shall slide on a No. 14 ga. three-inch long steel strap securely welded to rough bucks. The leg extending into the wall shall be crimped No. 14 ga. steel at least eight inches long where possible and three inches wide, except that the width shall not exceed the thickness of the masonry, nor shall the edge of the anchor come closer than 1/2 inch to the finished face of a wall.

3. Door frames in gypsum wall board partition walls shall be provided with welded-in steel anchors, which shall be screw-adjusted after the frame is installed, positioning the jambs solidly against wall structure.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication and Workmanship

1. All metal work shall be accurately fabricated and neatly assembled so as to be free from dents, tool marks, warpage, buckle or open joints. All lines shall be straight and true to curvatures as required, arises and angles as sharp as practical, moldings true to profile, mitres formed in true alignment, and abutting profiles shall intersect accurately.

2. Molded members and moldings shall be as shown on the Contract Drawings, unless otherwise approved. Stock molding shall be as shown on the Contract Drawings unless otherwise approved. Stock moldings which closely approximate the contours shown on the Contract Drawings will be accepted.

3. All items of template hardware, drilling and tapping shall be located by templates so that accurate alignment will be secured. Templates should be located before manufacturing is commenced.

4. All members shall be accurately fastened together so as to provide rigid construction in the assembled work. Removable members shall be secured with countersunk head tamperproof machine screws not more than 12 inches apart. All connections, except those of removable members shall be welded or interlocked.

5. All exposed face joints between members shall be continuously welded and dressed smooth and flush to be practically invisible.

6. Sinkages, cutouts and concealed reinforcement shall be provided as required for the proper installation and attachment of all hardware.

7. Sinkages shall be provided for butts lock fronts and strikes so that the exposed surfaces of hardware will finish flush with adjacent surfaces.

B. Labeled Work

1. Door openings to receive fire ratings as indicated on the Contract Drawings shall have frames and doors and equipment of gauges meeting the requirements for the rating noted by the OTCR. Frames and doors shall bear the necessary label and shall be labeled separately.

2. Each labeled door and frame shall be cut and reinforced to receive the type of hardware required.

C. Hardware

1. Furnish and apply, in connection with this work, all hardware not requiring special finish such as screws, anchors, braces, bolts, etc., as required to erect this work properly.

2. Finishing hardware will be furnished under Section 08 71 01 Finish Door Hardware. This Contractor shall, however, receive, check, store, and apply the finishing hardware insofar as it occurs in connection with Work under this Section. Protect door knobs by covering with cloth pads securely wired in place and do not apply escutcheons and other trim until directed to do so, by the Engineer.

3. Specified manufacturer's supplemental and special reinforcement for hinges, surface applied closers, holders, coordinators, stops and strikes shall be manufacturer's standard but not less than specified and recommended for maximum heavy-duty construction.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. All doors and frames specified herein shall be neatly installed in designated locations as shown on the Contract Drawings.

B. Installation shall be performed in strict accordance with the Contract Documents.

C. Fixed units shall be securely fastened in place and operative units adjusted to work properly.

D. Combination frames and trim shall be securely anchored in place with jambs filled solidly with mortar.

E. Do all necessary cutting, drilling, and fitting for securing Work in position including all necessary cutting, drilling, and tapping of the work to accommodate the work of other trades. Drilling and tapping for non-template hardware shall be performed at the Site.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. The Contractor shall provide protection against stains, dirt, or damage to the finished installation. The doors shall be adjusted at installation for proper operation. At conclusion of construction, doors shall have any final adjustments made in order to place the doors in perfect operating condition.

B. Upon completion of the project all finished work of this Section shall be carefully cleaned. Defective finish shall be removed and refinished, and all Work left clean and perfect.

END OF SECTION

SECTION 08 31 13 – ACCESS DOORS AND FRAMES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Access doors as specified herein shall include aluminum sidewalk doors, aluminum floor doors, and steel wall access doors to be mounted in masonry or gypsum board walls, ceiling access doors, and appurtenances.

B. Access doors shall be provided where shown on the Contract Drawings, specified herein, or as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	4

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 - Painting

1.04 REFERENCES

A. AASHTO H20 - American Association of State Highway and

Transportation Officials Standard Specification for Highway Bridges

B. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes, Standard Specification for

C. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for

D. NAAMM AMP 500-06 - National Association of Architectural Metal, Metal Finishes Manual

1.05 DESCRIPTION

A. Not Used.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to: catalog cuts, drawings, and reference materials. Submit for approval the following:

1. Copies of specifications, installation instructions, and general recommendations from the sidewalk door, floor door, and access door manufacturers for each type of product. Include manufacturer's data substantiating that the materials comply with the requirements of the Contract Documents.

2. Drawings showing extent of the Work and all details required for the Work referencing system components and installation requirements.

3. Calculations indicating compliance with performance criteria specified and used by the manufacturer for preparing details of fabrication, prepared, signed, and stamped with the seal of a Professional Engineer licensed to practice in the State of New York and recognized as an expert in the required Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged packaging with manufacturer's labels and seals intact.

2. Materials shall be protected from damage during storage primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled in such a manner to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed for the Site and shall not be incorporated into the Work.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall be as specified in the Contract.

1. Karp Associates, Inc., Maspeth, NY

2. Babcock-Davis, Brooklyn Park, MN

3. Williams Bros. Corporation of America, Front Royal, VA

4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Wall access doors shall comprise frames of a minimum of 16-gauge steel and doors of a minimum of 14-gauge steel. Access door assembly shall include concealed spring type hinges capable of opening to 170 degrees. Doors shall be furnished with flush locks, screwdriver operated, with metal cam. For fire-rated openings, doors shall bear a UL rating as required for the fire rating of the wall, but not less than 1-1/2 hour "B" label (250 degree F) rated, with frames of 16-gauge steel and insulated door with panels of 20-gauge steel, sandwich type, and continuous hinges.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Finishes: Access doors shall be finished as follows:

1. Wall access doors and frames shall be provided with a factory applied baked-on enamel prime coat chemically bonded to the steel. Doors and frames shall be field painted to match walls in accordance with Section 09 91 00 - Painting and the Contract.

2. Finish shall comply with NAAMM AMP 500-06 "Metal Finishes Manual" for recommendations for applying and designating finishes.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive access doors are properly prepared and completed to final elevations.

3.02 INSTALLATION

A. Wall access doors shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. All components of the Work shall be protected until Final Acceptance by DEP.

2. Work which cannot be completed before the onset of weather detrimental to the Work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.

3. Protect sidewalk doors, floor doors, and access doors from all damage and abuse until Final Acceptance by DEP.

B. Adjustment

1. Wall access doors, and their respective hardware components, shall be adjusted for proper alignment and smooth operation.

2. System components which are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Sections and properly protected as specified.

C. Cleaning

1. After installation, access doors shall be cleaned and left in a neat condition. Units shall be cleaned using materials and processes as recommended by the manufacturer.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 08 51 13 – ALUMINUM WINDOWS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and place into satisfactory service all high-performance, thermal-barrier, custom architectural grade aluminum windows and frames and auxiliary system components of the performance grade specified.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	8
1.07	Submittals	10
1.08	Delivery, Storage, and Handling	12
1.09	Spare Parts, Special Tools, and Supplies	13
1.10	Warranty	13
PART 2	PRODUCTS	13
2.01	Manufacturers	13
2.02	Materials / Equipment	14
2.03	Fabrication / Assembling / Finishes	16
2.04	Source Quality Control / Shop Tests	20
PART 3	EXECUTION	21
3.01	Examination / Preparation	21
3.02	Installation	22
3.03	Field Testing / Quality Control	22
3.04	Startup / Demonstration	22
3.05	Adjusting / Protection / Cleanup	22

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 08 81 03 - Glass Plastic and Glazing

1.04 REFERENCES

A.	NYCBC	-	New York City Building Code
B.	ASTM B117	-	Operating Salt Spray (Fog) Apparatus, Standard Practice For
C.	ASTM B136	-	Stain Resistance of Anodic Coatings on Aluminum, Standard Method for Measurement of
D.	ASTM B137	-	Coating Mass per Unit Area on Anodically Coated Aluminum, Standard Test Method for Measurement of
E.	ASTM B209	-	Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for
F.	ASTM B221	-	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes, Standard Specification for
G.	ASTM B244	-	Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments, Standard Test Method for Measurement of
H.	ASTM B584	-	Copper Alloy Sand Castings for General Application, Standard Specification for
I.	ASTM D522	-	Mandrel Bend Test of Attached Organic Coatings, Standard Test Methods for
J.	ASTM D523	-	Specular Gloss, Standard Test Method for
K.	ASTM D968	-	Abrasion Resistance of Organic Coatings by Falling Abrasive, Standard Test Method for
L.	ASTM D1308	-	Effect of Household Chemicals on Clear and Pigmented Coting Systems, Standard Test Method for
M.	ASTM D2244	-	Calculation of Color Tolerances and Color Differences From Instrumentally Measured Color Coordinates, Standard Practice for
N.	ASTM D2247	-	Testing Water Resistance of Coatings in 100% Relative Humidity, Standard Practice for
O.	ASTM D3363	-	Film Hardness by Pencil Test, Standard Test Method for
P.	ASTM E283	-	Determining the Rate of Air Leakage through Exterior Windows, Skylights, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen, Standard Test Method for

Q. ASTM E329 - Agencies Engaged in Construction Inspection, Testing Or Special Inspection, Standard Specification for

R. ASTM E330 - Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference, Standard Test Method for

S. ASTM E331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference, Standard Test Method for

T. American Architectural Manufacturers Association and the Window and Door Manufacturers Association, AAMA/NWWDA, 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

U. American Architectural Manufacturers Association, AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors

V. American Architectural Manufacturers Association, AAMA 800 - Voluntary Specifications Test Methods for Sealants

W. American Architectural Manufacturers Association, AAMA 910 - Voluntary 'Life Cycle'/Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors

X. American Architectural Manufacturers Association, AAMA 1503.1 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections

Y. American Society of Civil Engineers, ASCE 7 - Minimum Design Loads for Buildings and Other Structures

Z. Steel Structures Painting Council, SSPC Paint 12 - Paint Specification No. 12: Cold-Applied Asphalt Mastic (Extra Thick Film)

AA. Federal Specification, FS RR-W-365: Wire Fabric (Insect Screening)

1.05 DESCRIPTION

A. This Section describes exterior, high-performance, minimum 3-1/4-inch frame depth, factory-fabricated and factory-glazed, aluminum windows with integral structural polyurethane thermal-breaks and true divided muntins complying with the requirements of AAMA/NWWDA 101/I.S. 2 - Architectural Performance Class and Section 4 - Optional Performance Grades, all with Architectural Class I anodized finish or with a complete selection of factory-applied, four coat, custom and premium exotic color, custom blended full strength polyvinylidene fluoride finishes and colors with extended life topcoat, as selected in the Contract; all designed, detailed and fabricated as required to resist specified loadings, and resistance to air and water penetration specified and in accordance with the requirements of governing authorities having jurisdiction; associated high-

performance operating hardware, auxiliary system items, accessories, fasteners, and similar items for completely functioning systems.

B. Design Requirements

1. Comply with applicable standards and recommendations by AA, AAMA, and ASCE, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.

2. Comply with AAMA/NWWDA 101/I.S.2 including "non-mandatory" Appendix B, C, and D except where more stringent Wind Velocity Maps are included in ASCE 7 or other governing authorities having jurisdiction.

C. Modifications: Aluminum window and frame requirements shown are intended to establish basic dimensions of units, modules, profiles, mullion depths, sight lines, support locations of members, and the visual design intention. Within these limitations, the Contractor shall be responsible for the structural adequacy, weather resistance, thermal and condensation resistance, and the detailing and fabrication of all aluminum window and frame systems, including anchorage, and to make whatever modifications of, and additions to, the details as may be required to fulfill the minimum performance requirements of AAMA Optional Performance Grade and the requirements of non-mandatory Appendixes specified, at no additional expense to DEP. Maintain the visual design concept as shown, including member sizes, profiles, support locations and alignment of components.

D. Performance Criteria:

1. General:

a. The design wind load pressures for aluminum windows and frames shall be determined in accordance with analytical procedures established by ASCE 7 and shall take into consideration the load magnification effect caused by gusts in resonance with along-wind vibrations of flexible building and other structures. Professional engineer who prepares, signs, stamps its seal on Shop Drawings submitted to the Engineer shall take into consideration the need for wind-tunnel tests in order to include the effects of across-wind loading, vortex shedding or instability due to galloping or flutter of Project locations where channeling effects or buffeting in the wake of upwind obstructions warrant special consideration, or for those buildings or structures having unusual geometric shapes or response characteristics.

b. On Projects where the professional engineer believes such conditions may exist, provide the Engineer and the City with recommendations for further testing required to establish the design criteria for aluminum windows and frames. Identify all costs associated with such testing. Do not proceed with testing until given written approval by the City.

c. After carefully reading system performance criteria and other requirements of the Section, the professional engineer to whom design of the aluminum window and frame system is delegated shall make all requests for clarification of requirements that may be necessary in writing, to the Engineer.

2. Loading Analysis Criteria:

a. Wind Loads: Provide structural analysis, calculations and details indicating compliance with the NYCBC, ASCE 7-93 and ASCE 7-88, based on project location, heights and wind speed of 115 miles per hour (MRI 100 years), Ground Roughness (Exposure) Category D; Importance Factor based on ASCE 7 - Category IV - Essential Facility, and corresponding formula coefficients, to determine velocity pressures.

b. Seismic Loads: Provide aluminum window and frame system, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of the NYCBC or ASCE 7, Section 9, whichever are more stringent.

c. Dead Loads: Provide aluminum window and frame system components that do not deflect an amount that will reduce glazing bite below 75 percent of required glazing bite dimension when carrying full dead load. Provide minimum of 1/8 inch clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum of 1/16 inch clearance between members and operable windows and doors.

d. Live Loads: Provide aluminum window and frame system, including anchorage that accommodates supporting structure's deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

e. Deflection of Framing Members, ASTM E330: Maximum deflection of L/175 at center of single span when subjected to both positive and negative applicable design pressures, with no permanent deformation or damage of any main frame, sash, panel or sash member in excess of 0.2 percent of the span when the load is removed.

f. Provide complete loading analysis performance calculations and Shop Drawings for all aluminum window and frame system components prepared, signed, and stamped with the seal of a licensed professional engineer licensed to practice in the State of New York and recognized as an expert in the specialty involved.

3. Water and Air Infiltration Tests: A 5 foot-10 inch by 3 foot-1 inch window with a 4 foot-10 inch by 2 foot-10 inch minimum vent size shall comply with the following:

a. Static Test Pressure Water Penetration Testing, ASTM E331 and AAMA 910: After the AAMA 910 life cylce test, no evidence of uncontrolled water penetration to the interior of the building through the aluminum windows and frames when subjected to a static air pressure difference of 12 pounds per square foot.

b. Air Infiltration Testing, ASTM E283: After the AAMA 910 life cycle test, maximum air infiltration of 0.08 cubic feet per minute per square foot, when subjected to a static air pressure difference of 6.24 pounds per square foot.

4. Aluminum Window Classification (Grade): Based on AAMA/NWWDA 101/I.S.2, provide the following:

   a. Performance Class: In addition to General Requirements of Section 1, Gateway Performance Requirements established in Table 2.1, the Specific Performance Requirements of Section 2.2 and the Material and Component Requirements of Section 3, provide Optional Performance Class - Architectural AW, for all aluminum windows and frames.

   b. Performance Grade: As a minimum, provide Optional Performance Grade 65 aluminum windows and frames tested for structural test pressure of 1.5 times design pressure, unless structural calculations based on performance criteria specified identifies the need for more stringent optional performance grade for any area of the Project.

   c. Product Type: Provide AP - Projected Window and F - Fixed Window, as shown on the Contract Drawings.

5. Provide design, detailing and fabrication based on the most stringent combination of standards, testing and engineering analysis specified.

6. Thermal Movements: Aluminum window and frame system, including anchorage, shall withstand thermal expansion and contraction movements of system and supporting elements resulting from not less than an ambient temperature change of 120 degrees Fahrenheit, which may cause a surface curtain wall material temperature change of 180 degrees Fahrenheit. Limit the deflection as for wind pressure loading. Thermal movements shall not cause permanent deformation, cracking, opening of joints, undue stress on fasteners, or other effects detrimental to weathering performance.

7. The design of the aluminum window and frame system, including anchorage, as shown and specified, is intended to prevent excessive condensation on the indoor faces of the work, with the heating and ventilating system in operation, and under the following conditions. Provide aluminum window and frame system design, detailing, and fabrication in compliance with AAMA 1503.1 that achieves and maintains this design intention:

a. Outdoor: Ambient temperature 0 degrees Fahrenheit; 15 mph wind.

b. Indoor: Ambient temperature of 75 degrees Fahrenheit; relative humidity of 25 percent.

c. Excessive condensation is defined as visible water.

d. Condensation Resistance Factor: 58 minimum for frame.

8. Provide internal drainage to lead all infiltrated water to the exterior through weep slots.

9. Testing: Wherever manufacturer's standard window units comply with the requirements and have been tested in accordance with the specified tests, provide certification by the manufacturer of compliance with such tests; otherwise, perform the required tests through a AAMA accredited and recognized testing laboratory or agency and provide certified test results.

E. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the Work specified herein.

2. Notify other Contractors in advance of installation to provide them with sufficient time for the installation and coordination of interrelated items that are included in their Contracts and that must be installed in conjunction with the Work included in this Section.

3. Schedule the arrival of aluminum window and frame components and accessories to minimize the time they are stored at the Site before installation.

4. Do not proceed with the installation of aluminum window and frame system until Contractor can provide finished work complying with all requirements of the Sections.

5. Where aluminum window and frame systems require the building-in of plates, inserts, and other items, furnish required inserts to avoid delay in the work of other trades. Provide setting drawings, templates, and directions for installation of plates, inserts, and anchors, required by the Work of this Section but installed under other Sections.

6. Coordinate with other work by furnishing Shop Drawings, inserts, and similar items at the appropriate times for proper sequencing of construction without delays.

F. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

2. Coordinate supports, adjacent construction, and equipment locations to ensure actual dimensions correspond to dimensions established for aluminum window and frame system work.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer skilled, trained, and with successful experience in the installation of aluminum window and frame systems and with specific skill and successful experience in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work. Submit names and qualification to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owner, architects or engineers responsible for projects.

b. Approximate contract cost of the aluminum window and frame system.

c. Size of area installed.

2. Provide aluminum finish applicators experienced in the handling and application of the finish coatings specified, acceptable to the coating or aluminum manufacturer.

B. Professional Engineer:

1. Engage a registered professional engineer licensed in the State of New York and experienced in providing engineering services of the kind indicated.

2. Responsibilities include, but are not necessarily limited to, the following:

a. Carefully reviewing system performance and design criteria stated in the Contract Documents.

b. Preparing written requests for clarification or interpretation of performance or design criteria for submittal to Engineer by Contractor.

c. Preparing, or supervising the preparation of, design calculations and reviewing and approving related Shop Drawings prepared by the aluminum window and frame system manufacturer prior to submission to Engineer; testing plan development, and test-result interpretations; and providing comprehensive engineering analyses verifying compliance of the system with the requirements of the Contract Documents.

d. Signing and sealing all calculations and engineering analyses.

e. Certifying that:

1) It has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and

2) The said design conforms to all applicable local, state and federal codes, rules and regulations and to the prevailing standards of practice.

C. Erection Tolerances:

1. Limit variations from plumb, level or dimensioned angle to the following:

a. 1/8-inch maximum deviation in 10 foot vertical or angular run, and in 20-foot horizontal runs.

b. 1/4-inch maximum deviation in 40-foot runs, all directions.

2. Limit variations from theoretical member locations shown, based on established floor lines and column lines, including variations from plumb and level, to the following:

a. 3/8-inch total maximum deviation for members at all locations.

b. 1/8-inch maximum change in deviation for members for 10-foot runs, all directions.

3. Limit offsets in end-to-end and edge-to-edge alignments of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:

a. 1/16-inch maximum offset in flush alignment, including members which are to be 1/2-inch or less out-of-flush, and including members which are separated 2-inches or less by a reveal or protrusion in the plane of the aluminum windows and frames.

b. 1/8-inch maximum offset in alignments which are to be out-of-flush by more than 1/2-inch or separated by a reveal or protrusion of more than 2- inch width.

D. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work in accordance with ASTM E329 and AAMA qualifications.

E. Mock-Up:

1. Before proceeding with final purchase of materials and fabrication of aluminum window and frame components, prepare a mock-up at the Project Site, including all components shown on Shop Drawings approved by Engineer, indicating the final relationship and configurations of the various parts and components and the quality of workmanship that shall be achieved in the Work.

2. Build mock-up the full height and width of opening, in a location selected by the Engineer, and part of an area to receive the Work of this Section.

3. Include all items that are part of the aluminum window and frame system including anchorages, insulating glass, and dry-seal joint system.

4. Incorporate materials and methods of fabrication and installation that are identical with Project requirements. Accepted mock-up may be incorporated into the finished Work.

5. Build as many mock-ups as required to obtain the Engineer's acceptance. Disassemble rejected mock-ups and remove all components from Site. Do not incorporate rejected mock-up components into the Work.

6. Aluminum window and frame installation that proceeds without an approved mock-up shall be stopped, and a mock-up prepared for the Engineer’s approval.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Samples: Submit for approval the following:

a. Each required aluminum finish, on 12-inch long extrusions and 6-inch square sheets, of the alloys to be used for the Work.

b. Establish samples of the required finish, for Engineer’s acceptance, prior to fabrication. Where normal color and texture variations are to be expected, include three or more units in each sample, to show the range of such variations. Provide minimum possible color range variations. Engineer reserves the right to reject material finishes with objectionable variations from the established samples.

c. Polyvinylidene fluoride coating manufacturer’s complete color charts showing all colors and finishes, including custom, special, and premium colors.

d. Each component and cut-away corner of each window complete with finish and operating hardware, 2 foot-0 inches long by 2 foot - 0 inches wide, minimum, before Engineer’s visit to manufacturer’s facility for approval of actual aluminum window and frame systems to be incorporated into this Project.

e. Engineer reserves the right to require samples demonstrating design, detailing and fabrication techniques and workmanship for each system auxiliary component and accessory, before fabrication proceeds.

f. One of each type of fastener employed, with statement of intended use.

g. Samples will be reviewed by Engineer for color, finish, and workmanship only. Compliance with all other requirements is the responsibility of Contractor.

2. Shop Drawings: Submit for approval the following:

   a. Window location chart and schedules of typical aluminum window and frame elevations showing all configurations of operators, sash and muntins, custom panning, and other cladding and flashing, fully dimensioned and coordinated with actual measurements obtained at the Project Site and required operating hardware and other auxiliary system components and accessories. Indicate clearly, and in a manner that is highlighted to Engineer, all deviations from the Contract Documents.

   b. Details of each aluminum window and frame system detailing conditions at openings, details of construction, location, and installation requirements of operating hardware and reinforcements, and details of joints, connections, and every typical composite member. Show all window and frame reinforcements including welds, plate lengths, locations and gauges for each component of operating hardware and internal reinforcement. Indicate metal thicknesses; types of fasteners and support locations; and erection tolerances.

   c. Copies of manufacturer's specifications, roughing-in diagrams, technical data and installation instructions for each aluminum window and frame system. Transmit copy of each instruction to the installer. Provide setting drawings, templates, instructions and directions for installation, operating instructions and maintenance data.

3. Operation and Maintenance Manual (O&M Manual): Upon completion of the Work, furnish copies of detailed maintenance manual including the following information:

   a. Product name and number.

   b. Name, address and telephone number of manufacturer and local distributor.

   c. Detailed procedures for routine maintenance and cleaning.

   d. Detailed procedures for light repairs such as dents, scratches and staining.

   e. Design calculations verifying compliance with performance criteria specified, acceptable to governing authorities having jurisdiction, prepared, signed and stamped with the seal of a registered professional engineer, as specified.

4. Certificates: Submit for approval the following:

   a. Copies of material purchase receipts indicating types of materials purchased and incorporated into this Project, signed by a certified and licensed Notary Public, verifying that material purchased for the work complies with material designations specified as confirmed by approved Shop Drawings.

   b. Proof of testing laboratory AAMA certification and copies of testing agencies background and experience in preforming similar tests to those specified.

   c. Registered professional engineer who prepares, signs, and stamps its seal shall provide a written statement confirming responsibility for the design and attest that the Work prepared meets the Sections and the requirements of governing authorities having jurisdiction, and conforms to the prevailing standards of practice for the type of Work specified.

   d. Design calculations, signed and sealed by a Professional Engineer registered in the state of New York.

5. Test Reports: Submit for approval the following:

   a. Valid AAMA "Notice of Product Certification" indicating that the aluminum windows and frames to be provided for this Project conform to AAMA/NWWDA 101 I.S.2.

6. Warranties: Submit for review:

   a. Copies of written warranties agreeing to replace aluminum window and frame system components that fail to perform as specified.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver aluminum window and frame system materials, components and accessories dry and undamaged, with manufacturer's protective wrapping intact.

2. Deliver aluminum window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.

3. Inspect aluminum window and frame system components upon delivery for damage. Remove and replace all damaged items.

B. Storage of Materials:

1. Do not store aluminum window and frame system components in contact with concrete or other materials that might cause corrosion or staining.

2. Store aluminum window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.

3. Provide a 1/4 inch space between aluminum window and frame system components in order to promote air circulation.

C. Handling of Materials:

1. Do not subject aluminum window and frame components to bending or stress.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

3. Handle material using appropriate hand wear and tools that do not damage finish of items to remain exposed.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to the City a manufacturer's warranty, in an acceptable and beneficial form, warranting to deliver without charge, replacement aluminum window and frame system components that develop leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified, within three years of the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall be as specified in the Contract.

1. Kawneer, Norcross, GA

2. EFCO Corporation, Monett, MO

3. Graham Architectural Products, York, PA

4. Or approved equal

B. Aluminum Anodic Coating:

1. Alumilite 215 Clear as manufactured by Alcoa, Incorporated, New York, NY.

2. Or approved equal.

C. Exposed Aluminum Polyvinylidene Fluoride Based Coating:

1. Duranar Metallic XL Specialty Color 4-Coat System as manufactured by PPG Industries Coatings and Resins Division, Incorporated, Pittsburgh, PA.
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Extrusions:

1. Provide extruded, double tubular aluminum mullions, muntins, pressure plates, snap covers, two-piece snap trim, sills and glazing stops, and trim, equal to ASTM B221, 6063-T5 alloy and temper as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.
2. Provide extrusions within commercial tolerances, formed true to details shown and free of defects impairing strength, durability, color or finish.

B. Sheets:

1. Provide aluminum sheet closures, auxiliary components and accessories, equal to ASTM B209, 5005 alloy for exposed sheet and 3003 alloy for non-exposed sheet or as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.
2. Provide thicknesses as follows:
    a. Principal Formed Sheet Members: 0.125-inches minimum thickness.
3. Provide sheet free of defects impairing strength, durability, color or finish.

C. Fasteners: Epoxy adhesives or non-magnetic stainless steel, guaranteed by the manufacturer to be non-corrosive and compatible with the aluminum window members, trim, hardware, anchors and other components of the window units.

1. Do not use exposed fasteners, except where unavoidable for the application of operating hardware. Match the finish of the metal surrounding fastener, unless otherwise specified.
2. Provide Philips flat-head machine screws for exposed fasteners, unless otherwise specified.

D. Thermal Separators: Integral, structural polyurethane.

E. Glass and Glazing Accessories: As specified in Section 08 81 03 – Glass Plastic and Glazing.

F. Wire Fabric Insect Screen and Frames: Provide insect screen and frames for each operable sash.

1. Provide 18 by 16 mesh of 0.009-inch diameter stainless steel wire, complying with FS RR-W-365, Type VI, mounted with polyvinylchloride

splines into 5/16-inch by 1-1/2-inch by 0.050-inch extruded tubular aluminum frames with finish to match window in color and performance; corners mitered, gusset reinforced and crimped.

2. Provide insect screens that mount into exterior or interior extruded tracks using two stainless steel leaf springs.

3. Where windows swing outward, and insect screens are mounted on interior, provide sliding wickets framed as for fixed insect screens and trimmed for a tight fit and durability during operation.

G. Weather-stripping: Provide double rows of manufacturer's replaceable EPDM stripping complying with ASTM D2000, secured in extruded aluminum ports at all vent perimeters.

H. Brackets, Gussets, Reinforcements and Splice Clips:

1. Provide aluminum brackets and reinforcements wherever possible. Where steel units are required for higher strength or other unavoidable necessity, hot-dip galvanize the pieces after fabrication, with 2.0 ounces zinc coating..

2. Where fasteners screw anchor into aluminum less than 0.125-inches thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive, pressed-in, spline grommet nuts.

I. Auxiliary Components and Accessories:

1. Provide extruded aluminum, nominal 0.062-inch thick wall, with exposed surfaces finished to match aluminum windows and frames in color and performance; concealed fasteners; all required weather seals; designed for unrestricted expansion and contraction.

2. Provide complete selection of exterior wrap-around custom panning accessories; two-piece head and jamb receptors; sills and sub sills with thermal-breaks, anchors and end dams; two-piece interior snap trim and clips; interior glazing adapters, expanders, receptors, stools and other trim necessary for a complete installation, as determined by Engineer.

3. Provide intermediate, thermally broken, expansion-type, vertical and horizontal integral mullions (stack; offset stack; and three-piece) and mullion covers in configurations and types as required for combinations of windows and sizes of window areas shown.

J. Bituminous Paint: Cold applied asphalt mastic complying with SSPC-Paint 12, compounded for 30-mil thickness per coat.

K. Expansion Anchor Devices: Where inserts are not provided to support the concrete structure, provide drilled-in expansion bolt anchors of either toothed-stainless steel or lead shield design.

L. Window Operation

1. General:

    a. Projected Windows: Swing-in or swing-out as shown, side-hinged vent sash and fixed window combinations as shown, provide operable sash with two balance-support arms, pivots with friction shoes and two cam handle operators; top mount cam handles if required for pole operation.

2. Operating Hardware:

    a. Strike and Cam: White bronze, UNS C86200 cast white manganese bronze complying with ASTM B584.

    b. Concealed Stainless Steel Hinges: Heavy-duty four-bar hinges with non-magnetic stainless steel balance arms. Provide sliding pivots with nylon friction-adjustable shoe in a stainless steel track.

    c. Limit Opening Device: Provide stainless steel adjustable hold-open limit arm with release key for all project-out operable windows.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General: Provide specified manufacturer's standard fabrication and accessories, except to the extent more stringent requirements are specified. Include complete system for assembly of components and anchorage of window units. Include all components of glass and factory-applied glazing system.

B. Sizes and Profiles: The required sizes for window units and the profile requirements are shown on the Contract Drawings. The details shown are based upon standard details by one manufacturer. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the size requirements, performance requirements and with minimum/maximum profile requirements shown and specified.

C. Frame and Vent: All members shall be double tubular; corners mitered, double-gusset reinforced, factory-sealed with sealant complying with AAMA 800 and crimped.

D. Water Control: Provide pressure equalization gasket on vent interior; vent and frame weeps, foam baffles, and exterior hoods to allow water to drain by gravity and resist wind-blown rain.

E. Provide field-mounted drip caps on vent exteriors above frame sill.

F. Operating Hardware:

1. Cut, reinforce, drill and tap frames and windows as required to receive operating hardware. Comply with manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

2. Design, detail and fabricate reinforcement for maximum heavy-duty use, consisted with required guarantee period and performance criteria specified.

G. Provide extruded aluminum true-divided muntins, and custom panning shapes as shown and specified.

H. Aluminum Window And Frame Coatings

1. General:

a. After fabrication of the aluminum windows and frames, prepare surfaces for finishing in accordance with recommendations of the aluminum producer and the finisher or processor.

b. Finish all components of each assembly simultaneously so as to attain complete uniformity of color.

c. Sequence the finishing and processing of materials in a predetermined bay-by-bay, floor-by-floor, wall-by-wall plan, which will minimize color and texture differences between adjacent components.

d. All internal and external members of aluminum windows shall be anodized, as specified.

2. Aluminum Anodic Coating:

a. General:

1) Adjust and control the direction of mechanical finishes specified to achieve the best overall visual effect.

2) Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for all aluminum components. Engineer reserves the right to reject aluminum fabrications at any time because of color or texture variations that exceed the range of variations established by means of range samples approved by Engineer.

3) Anodize all aluminum components specified to receive this finish, whether or not exposed in the finished work.

b. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; Aluminum Association Designation - M32 Medium Satin Directional Texture.

1) Hand Rubbed Finish: Where required to complete the work and provide uniform, continuous texture, provide hand rubbed finish to match medium satin directional texture specified in order to even out and blend in satin finishes produced by other means.

c. Provide non-etching chemical cleaning by immersing the aluminum in an inhibited chemical solution, as recommended by the coating

applicator, to remove all lard oil, fats, mineral grease and other contamination detrimental to providing specified finishes.

1) Clean and rinse with water between steps as recommended by the aluminum manufacturer.

d. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified which do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density and acid electrolytes to obtain specified colors in compliance with the designation system and requirements of the Aluminum Association. Comply with the following:

1) Provide Architectural Class I high density anodic treatment by immersing the components in a tank containing a solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; Aluminum Association Designation A41 - Clear.

2) Provide the following physical properties, as verified by independent laboratory testing procedures, performed by a laboratory acceptable to Engineer, as specified:

a) Anodic Coating Thickness, ASTM B244: 0.7-mil minimum.

b) Anodic Coating Weight, ASTM B137: 32-mg/sq. in. minimum.

c) Resistance to Staining, ASTM B136: No stain after 5 minutes dye solution exposure.

d) Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.

3) Anodization Tests: Prepare samples and perform tests on each rack load for ASTM B136 and ASTM B244 compliance, and each production shift for ASTM B137 compliance during the processing, to verify compliance with specified physical properties. Include coupons in each rack load of production material; retain samples and carefully record test date and area of building wall to receive the corresponding materials.

a) Seal finished anodized coatings using deionized boiling water to seal the pores and prevent further absorption.

3. Exposed Aluminum Polyvinylidene Fluoride Based Coating: Apply full strength polyvinylidene fluoride based coatings at the factory by coil

coating for sheet material and spray coating for extruded or factory-fabricated material. Provide a four coat finish system complying with the following:

a. Alkali clean and hot water rinse all surfaces to receive poly-vinylidene fluoride based finish.

b. Prepare a chemical conversion coating on the surface, using phosphates or chromates followed by a cold water rinse. Seal with a chromic acid rinse and dry, except where manufacturer recommends another method to achieve greater coating reliability.

c. Apply a base prime coat of epoxy paint to the prepared surface in its coil form, by reverse roller coating. Fully cure in a gas-fired oven to a dry film thickness of 0.2 - 0.4-mils. Follow with a barrier coat, 0.75 - 1.0-mil thick.

d. Apply color coat containing mica pearlescent or metallic flakes over the barrier coat by roller coating for coil material and airless or Ransburg electrostatic hand spray for extrusions and fuse at a peak metal temperature of 440 degrees F. Apply to a dry film thickness of 0.7-mil for coil coating and 1.2-mil for spray coating so that the total dry film is approximately 1.0-mil thick for coil material and 1.5-mil thick for extruded material.

e. Apply clear fluoropolymer topcoat to provide a dry film thickness of 0.4-0.8- mils. The entire four coat system shall have a dry film thickness of 2.6-mil minimum.

f. Provide the following physical properties, as proven by the following laboratory test methods acceptable to Engineer:

    1) Weathering, ASTM D4214: Chalking, not more than No. 8, after exposure for 5000 hours in Sunshine Arc Weather meter XWR using 60/60 cycle.

    2) Color Change, ASTM D2244: No greater than 5 N.B.S units after removal of external deposits and after exposure for 5000 hours in Sunshine Arc Weather meter XWR using 60/60 cycle.

    3) Humidity Resistance, ASTM D2247; no blisters after 3000 hours.

    4) Salt Spray, ASTM B117: Few scattered blisters no larger than ASTM No. 4, and no more than 1/16 inch creep from areas scribed to bare metal after 3000 hours.

    5) Dry Adhesion: No pick-off when tape tested over 1/16-inch cross hatch.

6) Wet Adhesion: No pick-off when tape tested over 1/16-inch cross hatch; extruded material only.

7) Boiling Water Adhesion: No pick-off when tape tested over cross hatch area after 1 hour immersion in distilled boiling water.

8) Water Immersion: No pick-off when tape tested over cross hatch area after immersion in aerated distilled water 80 ±10 degrees F after 500 hours.

9) Abrasion Resistance, ASTM D968: Coefficient of abrasion of 67 minimum.

10) Gloss, ASTM D523: 30±5 reflectivity at 60 degrees F.

11) Pencil Hardness, ASTM D3363: HB-H minimum.

12) Dry Film Thickness, ASTM D3363: Primer, 0.2-0.4 mils; barrier coat, 1.0 mils; color coating, 0.7-1.5 mils; clear topcoat, 0.4-0.8 mils.

13) Solvent Resistance: 100 Double MEK rubs minimum.

14) Flexibility, ASTM D522: No cracking prior to metal fracture.

15) Acid Resistance, ASTM D1308: 16 hour spot test with 5 percent hydrochloric acid - no effect.

16) Alkali Resistance, ASTM D1308: 16 hour spot test with 5 percent sodium hydroxide - no effect.

g. Provide specified polyvinylidene coating for all components of the aluminum window and frame system.

1) Complete selection of manufacturer's standard, custom and premium colors and coating system components for final selection by Engineer.

2) Engineer will select custom special extended life premium colors at time of Shop Drawing and Sample submission review, as specified in the Contract.

h. Protective Coating: Immediately upon completion of the aluminum mullions and frames finish, apply a transparent, color-coded, strippable-film coating, not less than 1.0 mil dry film thickness.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Provide engineering design calculations and details prepared, signed, and stamped with the seal of a registered professional engineer licensed to practice in the State of New York and recognized as an expert in the required work.

B. Engineer reserves the right, in consultation with DEP, to visit the aluminum window and frame manufacturer's facilities and determine if the proposed manufacturer's facilities are acceptable. Contractor shall include as part of the Work arranging, inclusive of their costs, three visits by four representatives of DEP and the Engineer to visit the manufacturer's facilities for the purpose of approving manufacturer's fabricating techniques and completed aluminum window and frame systems components proposed for installation as part of the Work of this Project, unless additional visits are required to determine compliance with Contract requirements.

C. Where required by Engineer in order to verify types of metal used in the Work, provide metallurgy laboratory analysis of system component materials.

D. Obtain all aluminum window and frame system components, operating hardware, custom panning, flashing, and accessories from the same manufacturer.

E. Engage a manufacturer who requires that a technical representative be present at the time of mock-up preparation and the start of installation and who requires that the completed Work be inspected by a technical representative of the aluminum window and frame manufacturer.

F. Provide aluminum windows and frames labeled with AAMA or WDMA Hallmark labels.

G. Factory and Site Quality Control Procedures: Provide schedules, details, isometrics, or explanatory sketches cross-referenced to Shop Drawings as required to ensure that both fabrication and installation are in accordance with the Contract Documents. Factory quality control procedures shall include, but not necessarily be limited to, the following:

1. Finishing Fabrication: Procedures and controls for tolerances, joinery, sleeves, reinforcement gussets, and finishes.
2. Finish and Match: Procedures required for the match of exposed surfaces.
3. Assembly and Pre-assembled Units: Welds, fasteners, glass, sealants, gaskets, and separators.
4. Sealing and Pre-assembled Units: As required by the sealant manufacturer. Include sealant documentation as part of Shop Drawing submissions.
5. Material Handling: Procedures, care, protection, shipping, storage and other requirements to insure safe arrival and handling of materials.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Contractor shall examine the alignment of substrates and the sequence of Work before erection of the custom aluminum window and frame systems work begins and notify the Engineer in writing of unsatisfactory conditions. Do not proceed

with the custom aluminum window and frame systems work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Custom aluminum window and frame systems work shall not be installed when there is no assurance of adequate, long-term protection by Contractor.

3.02 INSTALLATION

A. All windows shall be installed by factory-trained erectors in strict accordance with installation data provided by approved Shop Drawing submittals, and the specified requirements.

B. Do not install component parts that are observed to be defective in any way, including warped, bowed, dented, abraded, and broken members, and including damaged glass.

C. Do not cut, or trim, component parts during erection, in a manner that would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the custom aluminum window and frame systems. Return component parts which require alteration to the shop for refabrication, if possible, or for replacement with new parts.

D. Install component parts level, plumb, true to line, and with uniform joints and reveals. Provide required support secured to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers, and fillers. Use erection equipment that will not mar or stain finished surfaces and will not damage the component parts.

E. Apply a bituminous coating of approximately 30-mil dry film thickness, or other permanent dielectric separator, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.

F. Apply sealant in accordance with manufacturer’s written recommendations at joints, wipe off excess and leave exposed sealant surface clean and smooth.

G. Anchor components parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements which are intended or necessary.

3.03 FIELD TESTING / QUALITY CONTROL

A. Test installed units in conformance with AAMA 502 for air and water infiltration with the window manufacturer and DEP present.

B. Select test units as directed by the Engineer and use an AAMA-accredited laboratory provided by Contractor.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. Notify Contractor of protective treatment and other precautions required through the remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering at time of Final Acceptance.
2. Contractor shall advise Engineer, in writing, of protection and surveillance requirements that Contractor shall provide at no additional expense to DEP, to insure that aluminum windows and frame system will be without damage or deterioration at the time of Final Acceptance by DEP.
3. Where protective coating has been supplied, remove coating completely immediately before installation and when construction activities no longer requires its retention.
4. Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.
5. Do not install aluminum windows and frames until all Work that could damage aluminum window and frame systems has been completed.
6. Provide temporary closures until construction sequencing allows installation of aluminum window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Adjustment

1. All windows shall be adjusted for smooth operation and weathertight closure providing a tight fit at contact points and at weatherstripping after installation is complete and readjusted when necessary prior to Substantial Completion.
2. At the completion of the Work, restore adjacent Work, marred by the Work of this Section, to an undamaged and clean condition.
3. Adjacent Work that has been physically damaged, or that does not respond adequately to cleaning, shall be replaced with new materials at no additional expense to DEP.

C. Cleaning

1. Clean aluminum surfaces immediately after installation, exercising care to avoid damage of finish. Lubricate hardware and other moving parts.
2. Maintain the aluminum window and frame systems in a clean condition throughout the construction period, so that they will be without any evidence of deterioration or damage, other than the effects of normal weathering, at the time of Final Acceptance.
3. Select methods of cleaning that will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish, install, and place into satisfactory service all high-performance, thermal-barrier, steel windows and frames, and auxiliary system components, of the performance grade specified.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	7
1.07	Submittals	9
1.08	Delivery, Storage, and Handling	11
1.09	Spare Parts, Special Tools, and Supplies	11
1.10	Warranty	12
PART 2	PRODUCTS	12
2.01	Manufacturers	12
2.02	Materials / Equipment	13
2.03	Fabrication / Assembling / Finishes	13
2.04	Source Quality Control / Shop Tests	14
PART 3	EXECUTION	15
3.01	Examination / Preparation	15
3.02	Installation	16
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	16
3.05	Adjusting / Protection / Cleanup	16

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 07 90 00 - Joint Protection

B. Section 08 81 03 - Glass Plastic and Glazing

1.04 REFERENCES

A. NYCBC - New York City Building Code

B. ASTM A123/A - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. ASTM C1363 - Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus, Standard Test Method for

D. ASTM D3656 - Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns, Standard Specification for

E. ASTM E283 - Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen, Standard Test Method for

F. ASTM E330 - Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference, Standard Test Method for

G. ASTM E331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference, Standard Test Method for

H. American Architectural Manufacturers Association and the Window and Door Manufacturers Association, AAMA/WDMA, 101/I.S.2 - Standard Specifications for Windows, Doors, and Skylights

I. American Society of Civil Engineers, ASCE 7 - Minimum Design Loads for Buildings and Other Structures

J. American Welding Society, AWS, D1.1 -Structural Welding Code - Steel

K. Builders Hardware Manufacturers Association, BHMA, A156.18 – American National Standard for Materials and Finishes

L. Master Painters Institute, MPI, No. 18 – Primer, Zinc Rich Organic

M. Society for Protective Coatings, SSPC, SP 5 -White Metal Blast Cleaning

1.05 DESCRIPTION

A. This Section describes exterior, high-performance, minimum 3-1/4-inch frame depth, factory-fabricated and steel windows with integral structural polyurethane thermal-breaks and true divided muntins complying with the requirements of AAMA/WDMA 101/I.S. 2 - Architectural Performance Class and Section 4 - Optional Performance Grades, all with Architectural Class I anodized finish or with a complete selection of factory-applied, four coat, custom and premium exotic color, custom blended full strength polyvinylidene fluoride finishes and colors with extended life topcoat, all designed, detailed and fabricated as required

to resist specified loadings, and resistance to air and water penetration specified and in accordance with the requirements of governing authorities having jurisdiction; associated high-performance operating hardware, auxiliary system items, accessories, fasteners, and similar items for completely functioning systems.

B. Design Requirements

1. Comply with applicable standards and recommendations by AAMA, and ASCE, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.

2. Comply with AAMA/WDMA 101/I.S.2 including "non-mandatory" Appendix B, C, and D except where more stringent Wind Velocity Maps are included in ASCE 7 or other governing authorities having jurisdiction.

C. Modifications: Steel window and frame requirements shown are intended to establish basic dimensions of units, modules, profiles, mullion depths, sight lines, support locations of members, and the visual design intention. Within these limitations, Contractor shall be responsible for the structural adequacy, weather resistance, thermal and condensation resistance, and the detailing and fabrication of all steel window and frame systems, including anchorage, and to make whatever modifications and additions to, the details as may be required to fulfill the minimum performance requirements of AAMA Optional Performance Grade and the requirements of non-mandatory Appendixes specified, at no additional expense to DEP. Maintain the visual design concept as shown, including member sizes, profiles, support locations, and alignment of components.

D. Performance Criteria:

1. General:

a. The design wind load pressures for steel windows and frames shall be determined in accordance with analytical procedures established by ASCE 7 and shall take into consideration the load magnification effect caused by gusts in resonance with along-wind vibrations of flexible building and other structures. Professional engineer who prepares, signs, and stamps its seal on Shop Drawings submitted to Engineer shall take into consideration the need for wind-tunnel tests in order to include the effects of across-wind loading, vortex shedding, or instability due to galloping or flutter of Project locations where channeling effects or buffeting in the wake of upwind obstructions warrant special consideration, or for those buildings or structures having unusual geometric shapes or response characteristics.

b. On Projects where the professional engineer believes such conditions may exist, provide Engineer and DEP with recommendations for further testing required to establish the design criteria for steel windows and frames. Identify all costs

associated with such testing. Do not proceed with testing until given written approval by DEP.

c. After carefully reading system performance criteria and other requirements of the Section, professional engineer to whom design of the steel window and frame system is delegated shall make all requests for clarification of requirements that may be necessary, in writing, to Engineer.

2. Loading Analysis Criteria:

a. Wind Loads: Provide structural analysis, calculations, and details indicating compliance with the NYCBC, ASCE 7-93 and ASCE 7-88, based on Project location, heights and wind speed of 115 miles per hour (MRI 100 years), Ground Roughness (Exposure) Category D; Importance Factor based on ASCE 7 - Category IV - Essential Facility, and corresponding formula coefficients, to determine velocity pressures.

b. Seismic Loads: Provide steel window and frame system, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of the NYCBC or ASCE 7, Section 9, whichever are more stringent.

c. Dead Loads: Provide steel window and frame system components that do not deflect an amount that will reduce glazing bite below 75 percent of required glazing bite dimension when carrying full dead load. Provide minimum of 1/8 inch clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum of 1/16 inch clearance between members and operable windows and doors.

d. Live Loads: Provide steel window and frame system, including anchorage that accommodates supporting structure’s deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

e. Deflection of Framing Members, ASTM E330: Maximum deflection of L/175 at center of single span when subjected to both positive and negative applicable design pressures, with no permanent deformation or damage of any main frame, sash, panel or sash member in excess of 0.2 percent of the span when the load is removed.

f. Provide complete loading analysis performance calculations and Shop Drawings for all steel window and frame system components prepared, signed and stamped with the seal of a licensed professional engineer licensed to practice in the State of New York and recognized as an expert in the specialty involved.

3. Water and Air Infiltration Tests: A 5 foot-10 inch by 3 foot-1 inch window with a 4 foot-10 inch by 2 foot-10 inch minimum vent size shall comply with the following:

    a. Static Test Pressure Water Penetration Testing, ASTM E331 and AAMA 910: After the AAMA 910 life cycle test, no evidence of uncontrolled water penetration to the interior of the building through the steel windows and frames when subjected to a static air pressure difference of 12 pounds per square foot.

    b. Air Infiltration Testing, ASTM E283: After the AAMA 910 life cycle test, maximum air infiltration of 0.08 cubic feet per minute per square foot, when subjected to a static air pressure difference of 6.24 pounds per square foot.

4. Window Classification (Grade): Based on AAMA/WDMA 101/I.S.2, provide the following:

    a. Performance Class: In addition to General Requirements of Section 1, Gateway Performance Requirements established in Table 2.1, the Specific Performance Requirements of Section 2.2 and the Material and Component Requirements of Section 3, provide Optional Performance Class - Architectural AW, for all steel windows and frames.

    b. Performance Grade: As a minimum, provide Optional Performance Grade 65 steel windows and frames tested for structural test pressure of 1.5 times design pressure, unless structural calculations based on performance criteria specified identifies the need for more stringent optional performance grade for any area of the Project.

    c. Product Type: Provide AP - Projected Window and F - Fixed Window, as shown on the Contract Drawings.

5. Provide design, detailing and fabrication based on the most stringent combination of standards, testing and engineering analysis specified.

6. Thermal Movements: Steel window and frame system, including anchorage, shall withstand thermal expansion and contraction movements of system and supporting elements resulting from not less than an ambient temperature change of 120 degrees F, which may cause a surface curtain wall material temperature change of 180 degrees F. Limit the deflection as for wind pressure loading. Thermal movements shall not cause permanent deformation, cracking, opening of joints, undue stress on fasteners, or other effects detrimental to weathering performance.

7. The design of the steel window and frame system, including anchorage, as shown and specified is intended to prevent excessive condensation on the indoor faces of the work, with the heating and ventilating system in

operation, and under the following conditions. Provide steel window and frame system design, detailing and fabrication in compliance with AAMA 1503.1 that achieves and maintains this design intention:

a. Outdoor: Ambient temperature 0 degrees Fahrenheit; 15 miles per hour wind.

b. Indoor: Ambient temperature of 75 degrees Fahrenheit; relative humidity of 25 percent.

c. Excessive condensation is defined as visible water.

d. Condensation Resistance Factor: 58 minimum for frame.

8. Provide internal drainage to lead all infiltrated water to the exterior through weep slots.

9. Testing: Wherever manufacturer's standard window units comply with the requirements and have been tested in accordance with the specified tests, provide certification by the manufacturer of compliance with such tests; otherwise, perform the required tests through an AAMA accredited and recognized testing laboratory or agency and provide certified test results.

E. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the Work specified herein.

2. Notify other Contractors in advance of installation to provide them with sufficient time for the installation and coordination of interrelated items that are included in their Contracts and that must be installed in conjunction with the Work included in this Section.

3. Schedule the arrival of steel window and frame components and accessories to minimize the time they are stored at the Site before installation.

4. Do not proceed with the installation of steel window and frame system until Contractor can provide finished work complying with all requirements of the Sections.

5. Where steel window and frame systems require the building-in of plates, inserts and other items, furnish required inserts to avoid delay in the work of other trades. Provide setting drawings, templates, and directions for installation of plates, inserts and anchors, required by the Work of this Section but installed under other Sections.

6. Coordinate with other work by furnishing Shop Drawings, inserts and similar items at the appropriate times for proper sequencing of construction without delays.

F. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

2. Coordinate supports, adjacent construction, and equipment locations to ensure actual dimensions correspond to dimensions established for steel window and frame system work.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer skilled, trained, and with successful experience in the installation of steel window and frame systems and with specific skill and successful experience of 10 years in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owner, architects, or engineers responsible for projects.

b. Approximate contract cost of the steel window and frame system.

c. Size of area installed.

2. Provide steel finish applicators experienced in the handling and application of the finish coatings specified, acceptable to the coating or steel manufacturer.

B. Professional Engineer:

1. Engage a registered professional engineer licensed in the State of New York and experienced in providing engineering services of the kind indicated.

2. Responsibilities include, but are not necessarily limited to, the following:

a. Carefully reviewing system performance and design criteria stated in the Contract Documents.

b. Preparing written requests for clarification or interpretation of performance or design criteria for submittal to Engineer by Contractor.

c. Preparing, or supervising the preparation of design calculations, and reviewing and approving related Shop Drawings prepared by the steel window and frame system manufacturer prior to submission to Engineer; testing plan development, and test-result interpretations; and providing comprehensive engineering analyses verifying compliance of the system with the requirements of the Contract Documents.

d. Signing and sealing all calculations and engineering analyses.

e. Certifying that:

1) It has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and

2) The said design conforms to all applicable local, state, and federal codes, rules, and regulations and to the prevailing standards of practice.

C. Erection Tolerances:

1. Limit variations from plumb, level or dimensioned angle to the following:

a. 1/8-inch maximum deviation in 10 foot vertical or angular run, and in 20 foot horizontal runs.

b. 1/4-inch maximum deviation in 40 foot runs, all directions.

2. Limit variations from theoretical member locations shown, based on established floor lines and column lines, including variations from plumb and level, to the following:

a. 3/8-inch total maximum deviation for members at all locations.

b. 1/8-inch maximum change in deviation for members for 10 foot runs, all directions.

3. Limit offsets in end-to-end and edge-to-edge alignments of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:

a. 1/16-inch maximum offset in flush alignment, including members which are to be 1/2-inch or less out-of-flush, and including members which are separated 2-inches or less by a reveal or protrusion in the plane of the steel windows and frames.

b. 1/8-inch maximum offset in alignments which are to be out--of-flush by more than 1/2-inch or separated by a reveal or protrusion of more than 2- inch width.

D. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer’s satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work in accordance with ASTM E329 and AAMA qualifications.

E. Mock-Up:

1. Before proceeding with final purchase of materials and fabrication of steel window and frame components, prepare a mock-up at the Project Site, including all components shown on Shop Drawings approved by Engineer,

indicating the final relationship and configurations of the various parts and components and the quality of workmanship that shall be achieved in the Work.

2. Build mock-up full height and width of opening, in a location selected by Engineer, and part of an area to receive the Work of this Section.

3. Include all items that are part of the steel window and frame system including anchorages, insulating glass, and dry-seal joint system.

4. Incorporate materials and methods of fabrication and installation that are identical with Project requirements. Accepted mock-ups may be incorporated into the finished Work.

5. Build as many mock-ups as required to obtain Engineer's acceptance. Disassemble rejected mock-ups and remove all components from Site. Do not incorporate rejected mock-up components into the Work.

6. Steel window and frame installation that proceeds without an approved mock-up shall be stopped, and a mock-up prepared for Engineer’s approval.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Samples: Submit for approval the following, but not limited to:

a. Typical sash corner 12 inch long each leg.

b. Typical muntin section 12 inch long.

c. Window frame with each specified finish on 12 inch long section.

d. Hardware, each item

2. Shop Drawings: Submit for approval the following:

a. Window location chart and schedules of typical window and frame elevations showing all configurations of operators, sash and muntins, custom panning, and other cladding and flashing, fully dimensioned and coordinated with actual measurements obtained at the Project Site and required operating hardware and other auxiliary system components and accessories. Indicate clearly, and in a manner that is highlighted to Engineer, all deviations from the Contract Documents.

b. Details of each window and frame system detailing conditions at openings, details of construction, including anchors, support framing, sheet metal trim members, location, and installation requirements of operating hardware and reinforcements, and details of joints, connections, and every typical composite member.

Show all window and frame reinforcements including welds, plate lengths, locations and gauges for each component of operating hardware and internal reinforcement. Indicate metal thicknesses; types of fasteners and support locations; and erection tolerances.

c. Copies of manufacturer's specifications, roughing-in diagrams, technical data, and installation instructions for each window and frame system. Transmit copy of each instruction to the installer. Provide setting drawings, templates, instructions and directions for installation, operating instructions, and maintenance data.

3. Operation and Maintenance Manual (O&M Manual): Upon completion of the Work, furnish copies of detailed maintenance manual including the following information:

   a. Product name and number.

   b. Name, address and telephone number of manufacturer and local distributor.

   c. Detailed procedures for routine maintenance and cleaning.

   d. Detailed procedures for light repairs such as dents, scratches and staining.

   e. Design calculations verifying compliance with performance criteria specified, acceptable to governing authorities having jurisdiction, prepared, signed and stamped with the seal of a registered professional engineer, as specified.

4. Certificates: Submit for approval the following:

   a. Copies of material purchase receipts indicating types of materials purchased and incorporated into this Project, signed by a certified and licensed Notary Public, verifying that material purchased for the work complies with material designations specified as confirmed by approved Shop Drawings.

   b. Registered professional engineer who prepares, signs, and stamps its seal shall provide a written statement confirming responsibility for the design and attest that the Work prepared meets the Sections and the requirements of governing authorities having jurisdiction and conforms to the prevailing standards of practice for the type of Work specified.

   c. Design calculation, signed and sealed by a Professional Engineer registered in the state of New York.

5. Test Reports: Submit for approval the following:

   a. Air Infiltration Test - ASTM E283-04 - Maximum air

      infiltration 0.37 CFM/FT of crack length with a

pressure differential of 6.24 PSF (50 MPH)

b. Water Penetration Test - ASTM E331-00 - No water penetration for 15 minutes when the window is subjected to a rate of flow of 5 Gal./Hr./Sq. Ft. with a pressure differential of 2.86 PSF.

6. Warranties: Submit for review:

a. Copies of written warranties agreeing to replace window and frame system components that fail to perform as specified.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver steel window and frame system materials, components, and accessories dry and undamaged, with manufacturer's protective wrapping intact.

2. Deliver steel window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.

3. Inspect steel window and frame system components upon delivery for damage. Remove and replace all damaged items.

B. Storage of Materials:

1. Do not store steel window and frame system components in contact with concrete or other materials that might cause corrosion or staining.

2. Store steel window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.

3. Provide a 1/4 inch space between steel window and frame system components in order to promote air circulation.

C. Handling of Materials:

1. Do not subject steel window and frame components to bending or stress.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

3. Handle material using appropriate handwear and tools that do not damage finish of items to remain exposed.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

B. Provide written warranty, signed by the manufacturer and naming the benefit to the City of New York, agreeing to replace, for a period of ten years from the date of Substantial Completion, steel window and frame finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:

1. Coating shall not spall, check, craze, peel, or otherwise lose adhesion for a period of ten years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet - 0 inches from the item.

2. In the event that the coil coated polyvinylidene fluoride-based coating fails to meet the specified standards, the manufacturer shall, at its own expense, replace or field paint, at the discretion of the City, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.

3. The warranty shall not apply where any failure is caused by accidents or any external conditions or forces beyond the control of the manufacturer.

C. Provide written warranty, signed by the manufacturer and naming the benefit to DEP, agreeing to replace steel window and frame system components that fail in material or workmanship within three years of the date of Substantial Completion. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weather-stripping, and other components of the system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Coating:

1. Duracron Coating as manufactured by PPG, Industries, Inc, Pittsburgh, PA.

2. Or approved equal.

B. Steel Polyvinylidene Fluoride Based Coating:

1. Duranar Metallic XL Specialty Color 4-Coat System as manufactured by PPG Industries Coatings and Resins Division, Incorporated, Pittsburgh, PA.
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Fasteners: Epoxy adhesives or non-magnetic stainless steel, guaranteed by the manufacturer to be non-corrosive and compatible with the steel window members, trim, hardware, anchors and other components of the window units.

1. Do not use exposed fasteners.

B. Thermal Separators: Integral, structural polyurethane.

C. Glass and Glazing Accessories: As specified in Section 08 81 03 – Glass Plastic and Glazing.

D. Reinforcements:

1. Internal reinforcement shall be provided in mullions with galvanized steel members to maintain rigidity.
2. Fasteners for Anchoring: Where type, size or spacing of fasteners for securing windows and accessories to building construction is not shown or specified, use expansion or toggle bolts or screws, instructed by manufacturer to suit application.

E. Accessories:

1. Provide complete selection of exterior wrap-around custom panning accessories; two-piece head and jamb receptors; sills and sub-sills with thermal-breaks, anchors and end dams; two-piece interior snap trim and clips; interior glazing adapters, expanders, receptors, stools and other trim necessary for a complete installation, as determined by Engineer.
2. Provide intermediate, thermally broken, expansion-type, vertical, and horizontal integral mullions (stack; offset stack; and three-piece) and mullion covers in configurations and types as required for combinations of windows and sizes of window areas shown.

F. Expansion Anchor Devices: Where inserts have not been provided in supporting concrete structure, provide drilled-in expansion bolt anchors of either toothed-stainless steel or lead shield design.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General: Provide specified manufacturer’s standard fabrication and accessories, except to the extent more stringent requirements are specified. Include complete system for assembly of components and anchorage of window units. Include all components of glass and factory-applied glazing system.

B. Sizes and Profiles: The required sizes for window units and the profile requirements are shown on the Contract Drawings. The details shown are based upon standard details by one manufacturer. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the size requirements, performance requirements, and with minimum/maximum profile requirements shown and specified.

C. Frame and Vent: All members shall be double tubular; corners mitered, double-gusset reinforced, factory-sealed with sealant complying with AAMA 800 and crimped.

D. Water Control: Provide pressure equalization gasket on vent interior; vent and frame weeps, foam baffles, and exterior hoods to allow water to drain by gravity and resist wind-blown rain.

E. Provide field-mounted drip caps on vent exteriors above frame sill.

F. Provide formed or extruded steel true-divided muntins, and custom panning shapes as shown and specified.

G. Steel Window and Frame Coatings

1. General:

a. After fabrication of the steel windows and frames, prepare surfaces for finishing in accordance with recommendations of the steel producer and the finisher or processor.

b. Finish all components of each assembly simultaneously so as to attain complete uniformity of color.

c. Sequence the finishing and processing of materials in a predetermined bay-by-bay, floor-by-floor, wall-by-wall plan, which will minimize color and texture differences between adjacent components.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Provide engineering design calculations and details prepared, signed, and stamped with the seal of a registered professional engineer licensed to practice in the State of New York and recognized as an expert in the required Work.

B. Engineer reserves the right, in consultation with DEP, to visit the steel window and frame manufacturer's facilities and determine if the proposed manufacturer's facilities are acceptable. Contractor shall include as part of the Work arranging, inclusive of their costs, three visits by four representatives of DEP and Engineer to visit the manufacturer's facilities for the purpose of approving manufacturer's fabricating techniques and completed steel window and frame systems components proposed for installation as part of the Work of this Project, unless additional visits are required to determine compliance with Contract requirements.

C. Where required by Engineer in order to verify types of metal used in the Work, provide metallurgy laboratory analysis of system component materials.

D. Obtain all steel window and frame system components, operating hardware, custom panning, flashing, and accessories from the same manufacturer.

E. Engage a manufacturer who requires that a technical representative be present at the time of mock-up preparation and the start of installation and who requires that the completed Work be inspected by a technical representative of the steel window and frame manufacturer.

F. Provide steel windows and frames labeled with AAMA or WDMA Hallmark labels.

G. Factory and Site Quality Control Procedures: Provide schedules, details, isometrics or explanatory sketches cross-referenced to Shop Drawings as required to insure that both fabrication and installation are in accordance with the Contract Documents. Factory quality control procedures shall include, but not necessarily be limited to, the following:

1. Finishing Fabrication: Procedures and controls for tolerances, joinery, sleeves, reinforcement gussets and finishes.
2. Finish and Match: Procedures required for the match of exposed surfaces.
3. Assembly and Pre-assembled Units: Welds, fasteners, glass, sealants, gaskets and separators.
4. Sealing and Pre-assembled Units: As required by the sealant manufacturer. Include sealant documentation as part of Shop Drawing submissions.
5. Material Handling: Procedures, care, protection, shipping, storage and other requirements to insure safe arrival and handling of materials.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Contractor shall examine the alignment of substrates and the sequence of Work before erection of the custom steel window and frame systems work begins and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the custom steel window and frame systems work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Custom steel window and frame systems work shall not be installed when there is no assurance of adequate, long-term protection by Contractor.

3.02 INSTALLATION

A. All windows shall be installed by factory-trained erectors in strict accordance with installation data provided by approved Shop Drawing submittals, and the specified requirements.

B. Do not install component parts that are observed to be defective in any way, including warped, bowed, dented, abraded, and broken members, and including damaged glass.

C. Do not cut, or trim, component parts during erection in a manner that would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the custom steel window and frame systems. Return component parts which require alteration to the shop for refabrication, if possible, or for replacement with new parts.

D. Install component parts level, plumb, true to line, and with uniform joints and reveals. Provide required support secured to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers, and fillers. Use erection equipment that will not mar or stain finished surfaces and will not damage the component parts.

E. Apply a bituminous coating of approximately 30-mil dry film thickness, or other permanent dielectric separator, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.

F. Apply sealant in accordance with manufacturer's written recommendations at joints, wipe off excess, and leave exposed sealant surface clean and smooth.

G. Anchor components parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements which are intended or necessary.

3.03 FIELD TESTING / QUALITY CONTROL

A. Test installed units in conformance with AAMA 502 for air and water infiltration with the window manufacturer and DEP's official present.

B. Select test units as directed by the Engineer and use an AAMA-accredited laboratory provided by Contractor.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. Advise Contractor of protective treatment and other precautions required through the remainder of the construction period, to ensure that window

units will be without damage or deterioration, other than normal weathering at time of Final Acceptance.

2. Contractor shall advise Engineer, in writing, of protection and surveillance requirements that Contractor shall provide at no additional expense to DEP, to ensure that steel windows and frame systems will be without damage or deterioration at the time of Final Acceptance by DEP.

3. Where protective coating has been supplied, remove coating completely immediately before installation and when construction activities no longer require its retention.

4. Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

5. Do not install steel windows and frames until all Work that could damage steel window and frame systems has been completed.

6. Provide temporary closures until construction sequencing allows installation of steel window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Adjustment

1. All windows shall be adjusted for a weathertight fit when necessary prior to Substantial Completion.

2. At the completion of the Work, restore adjacent Work, marred by the Work of this Section, to an undamaged and clean condition.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, and incidentals necessary to perform the Work of this Section as shown, specified, or required otherwise for a complete job.

B. Finish hardware is defined to include all items known commercially as finish hardware, as required for swing doors, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.

C. Types of finish hardware work required include, but are not necessarily limited to, the following:

1. Heavy-duty pivot hinges
2. Electric power transfer
3. Electrified mortise lock sets
4. Mortise locksets
5. Electrified vertical rod panic exit devices
6. Panic exit devices
7. Heavy-duty floor-mounted concealed door closers
8. Overhead surface-mounted door closers
9. Extra-heavy-duty overhead holders and stops
10. Magnetic monitor switch
11. Acoustic stripping and Seals
12. Thresholds
13. Silencers
14. Floor stops
15. Miscellaneous items

D. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2

1.05 Description 3
1.06 Quality Assurance 4
1.07 Submittals 4
1.08 Delivery, Storage, and Handling 6
1.09 Spare Parts, Special Tools, and Supplies 6
1.10 Warranty 6
PART 2 PRODUCTS 6
2.01 Manufacturers 6
2.02 Materials / Equipment 9
2.03 Fabrication / Assembling / Finishes 19
2.04 Source Quality Control / Shop Tests 19
PART 3 EXECUTION.....19
3.01 Examination / Preparation 19
3.02 Installation.....19
3.03 Field Testing / Quality Control 20
3.04 Startup / Demonstration 20
3.05 Adjusting / Protection / Cleanup.....20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Doors and Hardware Institute

1. Recommended Locations for Architectural Hardware for Doors Installed in Standard Steel Frames
2. Recommended Locations for Architectural Hardware for Doors Installed in Custom Steel Frames

B. South Coast Air Quality Management District (SCAQMD)

1. Rule 1113 -- Architectural Coatings
2. Rule 1168 -- Adhesives and Sealants

C. Green Seal (GS)

1. GS–11 -- Green Seal Standard for Paints and Coatings.
2. GC–03 -- Green Seal Environmental Criteria for Anti-Corrosive Paints.

D. ASTM C920 -- Standard Specification for Elastomeric Joint Sealants

1.05 DESCRIPTION

A. Where the finish, shape, size, or function of a member receiving finish hardware is such as to prevent the use of or make unsuitable for the types specified, furnish similar types having the same operation as nearly as practicable.

B. If finish hardware for any location is not specified, provide finish hardware equal in design and quality to adjacent finish hardware for comparable openings.

C. Furnish finish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.

D. Unless otherwise specified, comply with the technical guidance of Door and Hardware Institute (DHI), for locating hardware on standard or customized steel doors and frames, as applicable.

E. Provide stainless steel finish hardware or matching finish hardware as specified for all doors and frames.

F. Sustainable Design Requirements

1. VOC Content: Products applied on site and within the building's weatherproofing system shall comply with VOC limits of authorities having jurisdiction and the following VOC limits of when calculated according to SCAQMD Rule 1113 and Rule 1168, Green Seal Standard GS–11, Green Seal Criteria GC–03:

   a. Architectural Sealants: 250 g/L

   b. Sealant Primers for Nonporous Substrates: 250 g/L

   c. Sealant Primers for Porous Substrates: 775 g/L

   d. Multipurpose Construction Adhesives: 70 g/L

   e. Flat Paints and Coatings: VOC not more than 50 g/L

   f. Non flat Paints and Coatings: VOC not more than 150 g/L

   g. Primers, Sealers, and Under coaters: VOC not more than 200 g/L

   h. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.

G. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the finish hardware.

2. Coordinate the Work of other Sections in order to provide clearances and accurate positioning of recessed or cast-in-place items required by this Section.

1.06 QUALITY ASSURANCE

A. Supplier Qualifications: The finish hardware supplier shall have in his employ a member of the DHI as a certified Architectural Hardware Consultant who shall be responsible for checking, supervising, and preparing written Field Report for complete finish hardware installation and with on-Site presence during the time of installation and adjustment of the Work.

B. Requirements of Regulatory Agencies: Comply with the applicable requirements of governing authorities and codes for the types of finish hardware specified.

C. Source Quality Control: Obtain all similar products and accessories from the same manufacturer.

D. Substitutions

1. Clearly identify, in a manner which is highlighted to the Engineer, all proposed substitutions, modifications, variations, unspecified features, and "or approved equal" products. Provide complete comparative data, comparing "or approved equal" with specified products, at the time of Shop Drawings submission.

E. Do not make substitutions after the Engineer's approval of final finish hardware schedule and sample at time of Shop Drawing submission.

1.07 SUBMITTALS

A. Contractor shall submit the following to the Engineer for review and approval:

1. Actual unit of each finish hardware item specified incorporating all standard and special features and finishes specified, demonstrated and identified by supplier's representative to the Engineer. Samples shall be presented at the time of Shop Drawing submittal, as the Engineer will not review or approve Shop Drawings without concurrent sample submissions.

2. The Engineer's review will be for general quality and features of units; compliance with all other requirements is the exclusive responsibility of the Contractor.

3. Approved samples may be incorporated into the finish hardware work.

B. Shop Drawings:

1. Copies of manufacturer's data for each item of finish hardware. Include whatever information may be necessary to show compliance with requirements and include instructions for installations and for maintenance of operating parts and exposed finishes. Wherever needed, furnish templates to fabricators of other Work which is to receive finish hardware.

2. Copies of the finish hardware schedule. Include a separate key schedule, showing clearly how City's final instructions on keying of locks have been fulfilled. Finish hardware schedules are intended for coordination of the Work. Review and acceptance by the Engineer does not relieve the

Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

3. Based on the finish hardware requirements specified, organize the final finish hardware schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other Work (such as stainless steel frames) which may be critical in the Project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with Shop Drawings for other Work, delivery schedules, and similar information have been complete and accepted.

4. Copies of manufacturers' specifications and installation instructions for required materials and components, which are not included in other submittals specified in other Sections. Coordinate the requirements of this Section with other submittals and coordinate the submittal of other data in other Sections with this Sections' submittal.

5. Maintenance Manual: Upon completion of the Work, furnish copies of detailed maintenance manuals, including the following information:

   a. Product name and manufacturer.

   b. Name, address and telephone number of manufacturer and local distributor.

   c. Detailed procedure for routine maintenance and cleaning.

   d. Detailed procedures for repairs such as dents, scratches and staining.

   e. Parts identification manual and maintenance manuals for each piece of finish hardware.

C. Cylinders and Keying System:

1. Provide a great grandmaster keying system.

2. Equip all locks with manufacturer's special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.

3. Comply with Engineer's instructions for master keying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

4. Key Material: Provide keys of nickel silver only.

5. Key Quantity: Furnish three keys for each lock and five keys for each master and grandmaster system. Provide one extra key blank for each lock.

D. Test Reports: Submit for approval certified laboratory test reports for required performance tests.

E. Sustainable Design Submittals:

1. VOC Reporting Form. Provide the following information:

F. Finish hardware schedule

G. For all paints, coatings, sealants and adhesives used on site and within the building's weatherproofing system provide the VOC content in grams/liter (g/L) less water and other exempt compounds, if applicable.

H. Written field report on condition of each item of finish hardware actually present on each door at the Project Site with each item referenced to the approved Shop Drawings. Final approval or final payment shall not be provided to Contractor until field report has been submitted to and approved by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver finish hardware sufficiently in advance of its setting for proper inspection.

2. Pack each piece of finish hardware separately, complete with screws, keying, instructions and templates, tagged to correspond with the approved finish hardware schedule.

3. Deliver individually packaged finish hardware items at the proper time to the proper locations for installation.

B. Storage of Materials:

1. Provide secure lock-up for finish hardware stored at the Project Site, but not yet installed.

2. Store finish hardware in manufacturers' original packages.

C. Handling of Materials: Control the handling and installation of finish hardware items which are not immediately replaceable, so that the completion of the Work will not be delayed by finish hardware losses, both before and after installation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Heavy Duty Pivot Hinges:

1. H147 Bottom Pivot, H180 Top Pivot and M190 Heavy-Duty Intermediate Pivots as manufactured by:

a. Rixson, a subsidiary of Yale Security, Incorporated, Monroe, NC.

b. Or approved equal.

B. Electric Power Transfer:

1. EPT-10 Electric Power Transfer as manufactured by Von Duprin or EPT-2 for magnetic monitor switches, Indianapolis, IN.

2. Or approved equal.

C. Electric Mortise Lock Sets

1. Heavy-Duty Mortise Lockset L9080 PEL RX with RX (request to exit) function, Lever Handle 03N (plug only to show) with MS750 24 VAC, 3 amp transformer as manufactured by Schlage, Carmel, IN. Provide EL (electric locking) series at all doors except at exterior doors and as noted otherwise.

2. Or approved equal.

D. Mortise Lock Sets

1. Heavy-Duty Mortise Lock Set, Newport N9M (ANSI No. 14), by Corbin Russwin, an ASSA ABLOY Group Company.

2. Or an approved equal.

E. Electrical Vertical Rod Panic Exit Device

1. Electric panic device EL 9848L SS RX (signal switch and request to exit) Lever Set 03 by Von Duprin, Indianapolis, IN, with (latches top and bottom) with MS750 24 VAC, 3 amp transformer.

2. Or approved equal.

F. Panic Exit Devices

1. ED5200A 3-Hour Fire Listed Surface Rim Exist Device, Finish BHMA 630 (ANSI A156.3, Type 1, Grade 1) by Corbin Russwin, an ASSA ABLOY Group Company.

2. Or an approved equal.

G. Vertical Rod Panic Exit Devices

1. ED5400A 3-Hour Fire Listed Surface Vertical Rod Exist Device, Finish BHMA 630 (ANSI A156.3, Type 2, Grade 1) by Corbin Russwin, an ASSA ABLOY Group Company.

2. Or approved equal.

H. Heavy Duty Floor Mounted Door Closer

1. SC H27CWF by Rixson, a Subsidiary of Yale Security, Inc., an ASSA ABLOY Group Company, Monroe, NC.

2. Or approved equal.

I. Overhead Surface-Mounted Door Closer

1. DC8000 Parallel Arm Mounting Heavy-Duty Non-Hold Open Arm with Stop (DC8210 Series), by Corbin Russwin, an ASSA ABLOY Group Company.
2. Or approved equal.

J. Extra Heavy-Duty Overhead Holders and Stops

1. 904H – US32D Extra Heavy-Duty Surface-Mounted Overhead Door Holder/Stop as manufactured by Glynn-Johnson Part of Worldwide Ingersoll-Rand, Dublin, Ireland
2. Or approved equal.

K. Flash Bolts and Automatic Flush Bolts (forged/wrought brass parts)

1. FB458 Manual Flush Bolts, US26D finish, as manufactured by Ives, Part of Worldwide Ingersoll-Rand, Dublin, Ireland.
2. Or approved equal.

L. Flush Bolts and Automatic Flush Bolts (cast bronze parts)

1. FB31P Automatic Flush Bolts, US32D finish, by Ives, Part of Worldwide Ingersoll-Rand, Dublin, Ireland.
2. Or approved equal.

M. Coordinators

1. COR52-US26D by Ives, Part of Worldwide Ingersoll-Rand, Dublin, Ireland.
2. Or approved equal.

N. Astragals

1. 357C by Pemko Manufacturing Company, Memphis, TN.
2. Or approved equal.

O. Dust-Proof Strikes

1. DP1 and DP2 as manufactured by Ives, Part of Worldwide Ingersoll-Rand, Dublin, Ireland.
2. Or approved equal.

P. Magnetic Monitor Switch

1. RX (exit device) or LX (latch-bolt) magnetic monitor switch with PT 750 24 VAC transformer by Von Duprin, Indianapolis, IN.
2. Or approved equal.

Q. Weather-stripping (bumper type)

1. No. 170AA by Zero International, Inc., Bronx, NY.

2. Or approved equal.

R. Acoustic Seals

1. 3708AA (Head and Jambs), 368AA (Semi-Mortised Automatic Door Bottom), and 564A (Threshold) by Zero International, Inc, Bronx, NY.

2. Or approved equal.

S. Thresholds

1. 655A (interior saddles) by Zero International, Inc., 800 (doors with floor closers), Type 3 Offset by Rixson, a Subsidiary of Yale Security, Inc., an ASSA ABLOY Group Company, Monroe, NC.

2. Or approved equal.

T. Offset Thresholds

1. 566A (interior doors) by Zero International, Inc., No. 700 (with floor closers) thresholds by Rixson, A Subsidiary of Yale Security, Inc., an ASSA ABLOY Group Company, Monroe, NC. Provide Offset Threshold of similar design as required.

2. Or approved equal.

U. Silencers

1. SR 64 by Ives, Part of Worldwide Ingersoll-Rand, Dublin, Ireland.

2. Or approved equal.

V. Stops

1. FS13, US26D finish, by Ives, Part of Worldwide Ingersoll-Rand.

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Requirements for All Products

1. Hand of Door: Contract Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of finish hardware for proper installation and operation of the door swing as shown.

2. Manufacturer's Nameplate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates).

3. Base Metals: Produce finish hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper, and hardness. Do not substitute materials or forming methods for those specified.

4. Fasteners: Manufacture finish hardware to conform to published templates, generally prepared for machine screw installation. Do not provide finish

hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

5. Furnish screws for installation, with each finish hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of finish hardware, base material or fastener.

7. Provide concealed fasteners for finish hardware units which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation when the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to adequately reinforce the Work and use machine screws or concealed fasteners of another standard type of satisfactorily avoid the use of through bolts.

8. Tools for Maintenance: Furnish a complete set of specialized tools as needed for City's continued adjustment, maintenance, removal, and replacement of finish hardware.

B. Heavy-Duty Pivot Hinges

1. Templates and Screws: Provide only template-produced units.

2. Base Metal: Fabricate hinges from forged bronze with US 26D Satin Chrome finish.

3. Number of Hinges: Provide three hinges on each door leaf of less than 60-inches height; provide one additional hinge for next 30-inches of door height; provide two additional hinges for each 30-inches or fraction thereof for doors above 90-inches tall.

4. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:

   a. Exterior and Interior Doors, maximum 48-inches wide: Top and bottom pivots; intermediate pivots based on number of hinges as specified; minimum of one intermediate pivot required on all doors.

5. Types of Hinges: Provide all doors with offset hung, bottom, top and intermediate units with hardened steel pivot pins treated to prevent rusting or binding, permanently seated in an oil impregnated sintered bronze bearing lubricated for the life of the door and capable of supporting a minimum door weight of 800 pounds and recommended by the manufacturer for use on heavy-duty high traffic doors subject to extreme

abuse. Provide single acting, mortised mounted units sized for a maximum door width of 4 foot-0 inches. Top pivot shall have a sloped top surface.

C. Electric Power Transfer

1. Provide this accessory at all locations where electrified hardware is provided through door leafs.

D. Electrified Mortise Locks Sets

1. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finish to match lock or latch set trim. Device to be UL certified to respond by solenoid operation to lock or unlock and contain a request to exit function microswitch interconnected with interior knob.
2. Lock Throw: Provide minimum of 1-inch anti-friction latch bolt and one-inch dead bolt throw wherever available on manufacturer's functions specified.
3. Materials: Provide the following materials:
    a. Latch Bolt: Stainless steel.
    b. Dead Bolt: Stainless steel.
    c. Case: Stainless steel.
    d. Hub: Nickel steel.
    e. Scalp: Stainless steel.
    f. Escutcheon: 8-1/2-inches by 1-3/4-inches stainless steel; US 32D; Satin Stainless Steel.
4. Backset: Provide minimum backset of 2-3/4-inches.
5. Finish: US32D Satin Stainless Steel.

E. Mortise Locks Sets

1. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finish to match lock or latch set trim.
2. Lock Throw: Provide minimum of one-inch anti-friction latch bolt and one-inch dead bolt throw wherever available on manufacturer's functions specified.
3. Materials: Provide the following materials:
    a. Latch Bolt: Stainless steel.
    b. Dead Bolt: Stainless steel.
    c. Case: Stainless steel.

d. Hub: Nickel steel.

e. Scalp: Stainless steel.

f. Escutcheon: 8-1/2-inches by 1-3/4-inches stainless steel; US 32D; Satin Stainless Steel.

4. Backset: Provide minimum backset of 2-3/4-inches.

5. Finish: Us32d Satin Stainless Steel.

F. Electrified Vertical Rod Panic Exit Devices

1. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown. Device to be UL certified to respond by solenoid operation to lock or unlock and contain a request to exit function micro-switch interconnected with exit accessory.

2. Exit Doors: Where required by governing regulations, or where shown or scheduled, provide panic exit devices of the type required. Provide units for 1-3/4-inch thick doors.

3. Lock Throws: Provide minimum of 3/4-inch latch bolt throws.

4. Provide surface-applied two-point latching exit devices as specified.

5. Provide the following materials:

a. Latch Bolt: Stainless steel.

b. Case: Stainless steel.

c. Cylinders: Brass.

d. Front: Stainless steel.

e. Chassis: Brass.

f. Crossbar: Oval, seamless, knurled crossbar with interlocking expansion collets and roll pins; satin stainless steel; 0.062-inches minimum thickness with steel reinforcing tube.

6. Backset: Provide minimum backset of 2-3/4-inches.

7. Finish: US 32D Stainless Steel.

8. Function: ANSI No. 4: entrance by trim when latch bolt is retracted by key or set in a retracted position by key; no thumbpiece.

G. Vertical Rod Panic Exit Devices

1. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown.

2. Exit Doors: Where required by governing regulations or where shown or scheduled, provide panic exit devices of the type required. Provide units for 1-3/4-inch thick doors.
3. Lock Throws: Provide minimum of 3/4-inch latch bolt throws.
4. Provide surface-applied two-point latching exit devices as specified.
5. Provide the following materials:
    a. Latch Bolt: Stainless steel.
    b. Case: Stainless steel.
    c. Cylinders: Brass.
    d. Front: Stainless steel.
    e. Chassis: Brass.
    f. Crossbar: Oval, seamless, knurled crossbar with interlocking expansion collets and roll pins; satin stainless steel; 0.062-inches minimum thickness with steel reinforcing tube.
    g. Backset: Provide minimum backset of 2-3/4-inches.
    h. Finish: US 32D Stainless Steel.
    i. Function: ANSI No. 4: entrance by trim when latch bolt is retracted by key or set in a retracted position by key; no thumbpiece.

H. Floor Mounted Heavy-Duty Door Closers

1. Provide heavy-duty single-acting floor mounted door closers for all doors, and as recommended by the manufacturer for controlling doors weighing up to 800 pounds in high traffic and high abuse situations. Provide recessed floor mounted door closers for all doors.
2. Size of Units: 6-1/2-inches wide by 13-1/4-inches long by 4-inches deep.
3. Provide dress plates and other finished hardware components of satin chrome finish.
4. Provide low temperature hydraulic fluid for all units. Seal units using an adhesive backed rubber gasket.
5. Provide extended spindle as required to accommodate detailing shown.
6. Provide 3/4-inch offset heavy-duty arm coordinated with pivot hinge manufacturer's recommendations for heavy-duty pivot hinges.
7. Provide special cement case anchoring angles mounted on both sides of cast-iron cement case. Provide manufacturer's floor installation template and former kit.
8. Provide heavy-duty units fire-rated and complying with all required governing standards.

9. Provide the following materials and features in addition to others specified herein:
    a. Provide both floor plate and threshold installation as required.
    b. Provide floor plate with US26D finish.
    c. Bottom arm with anti-friction bearing.
    d. Closing speed adjustment valve and separate latch speed adjustment valve.

I. Overhead Surface-Mounted Door Closers

1. Provide all doors, unless specially scheduled or specified as being provided with floor mounted or concealed overhead closers, with surface-mounted overhead door closers. Provide both active and inactive door leafs with closers.
2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
5. Comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA No. 80 for doors requiring door closers. Modify closers specified as required.
6. Provide hold open feature for all non-fire rated doors unless otherwise specified.
7. Provide corner bracket mounting on exterior doors. Select all arms to clear weatherstripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor mounted stops.
9. Provide closers with spring power adjustment feature capable of increasing spring power 15 percent minimum in all closer sizes.
10. Provide individual regulating valves for closing and latching speeds, and separate adjustable backcheck valve.
11. Provide delayed closing action feature on all door closers. Position valve at top of closure.
12. Provide the following materials and features in addition to others specified herein:
    a. Full Metal Cover: Aluminum.
    b. Case: Cast iron.

c. Arms: Plated to match full metal covers.

d. Other Parts: Steel.

e. Extreme temperature fluid.

f. Security torx machine screws.

g. Ten year warranty.

h. Provide manufacturer's optional corrosion protection.

13. Finishes: S26D Satin Chrome. Color coordinate all arms and other accessories.

14. Highly Corrosive Atmospheres: Provide all closers with specified manufacturers.

J. Extra Heavy-Duty Overhead Holders and Stops

1. Provide surface-mounted extra heavy-duty overhead holders and stops on all leafs of all doors with hold open feature.

2. Material: Provide the following materials:

a. Arm: Stainless steel; 1/4-inch thick.

b. All Other Parts: Stainless steel.

3. Coordinate placement of extra heavy-duty overhead holder and stop with weatherstripping for non-interference.

4. Design and reinforce connections of extra heavy-duty holder and tops where they are fasteners to other materials, to resist a superimposed load of 30 pounds per square foot acting on the plane of the doors. Mount to door using a minimum of four countersunk mounting holes with four 3/8-inch diameter stainless steel sex bolts.

5. Provide all manufacturer recommended door reinforcements and coordinate the furnishing of hardware templates required for the installation of the units.

6. Finish: US 32D stainless steel, satin finish.

K. Flush Bolts And Automatic Flush Bolts

1. Provide flush bolts on the inactive leaf of all pairs of doors, unless otherwise specified.

2. Provide flush bolts at the top and bottom of door.

3. Materials: Provide the following materials:

a. Flush Bolt Levers: Forged Brass.

b. Flush Bolt Plate: Forge Brass.

c. Flush Bolt Guide and Strike: Wrought Brass.

d. Flush Bolt Rods: 1/2-inch round rods, bronze, 12-inch minimum length.

4. Provide extension flush bolts with 3/4 inch throws and with top bolt not over 6 foot-0 inches above finished floor. Provide bottom flush bolt 12-inches long.

5. Where required by governing authorities provide cast bronze automatic flush bolts bearing the UL label.

L. Coordinators

1. Provide coordinator device on all pairs of doors required or specified to have automatic flush bolts, or panic exit devices. Comply with UL, List of Inspected Fired Protection Equipment and Material, and NFPA No. 80 requirements.

2. Provide manufacturer's standard carry bar and strike on all pairs of doors equipped with coordinator.

3. Materials: Bronze.

4. Finish: US 32D Satin Stainless Steel.

M. Astragals

1. Provide metal astragal bar, not less than 1/8-inch by two-inches, for exposed flathead screw mounting on active leaf of all pairs of doors.

2. Provide astragal of extruded aluminum with clear anodized finish.

N. Dust-Proof Strikes

1. Provide brass dust-proof strikes which incorporate a slotted plunger raised to flush position by spring tension for all flush bolts.

2. Provide 5/8-inch inside diameter dust-proof strikes; threshold mounted and surface mounted.

3. Finish: US 26D Satin Chrome.

O. Magnetic Monitor Switch

1. Provide stainless steel magnetic monitor switch which incorporates a magnet set into the door leaf head and an actuator set into the corresponding position in the frame which will electronically monitor the door leaf position.

2. Provide magnetic monitor switch; flush (full mortized) mounted into frame and door leaf head.

3. Finish: US 4.

P. Weatherstripping And Acoustic Seals

1. Provide perimeter weatherstripping at all exterior doors. Provide acoustic stripping and seals for interior doors where scheduled.

2. Continuity of Stripping: Except as otherwise specified, it is required that the stripping at each opening be continuous and without unnecessary interruptions at door corners and hardware.

3. Replaceable Seal Strips: It is required that the resilient or flexible seal strip of every unit be easily replaceable and readily available from stocks maintained by the manufacturer.

4. Provide bumper-type weatherstripping at jambs and head, including a resilient insert and metal retainer strip, surface-applied of the following metal, finish and resilient bumper material:

   a. Housing: Extruded aluminum with clear anodized finish; 0.062-inch minimum thickness of main walls and flanges.

   b. Dimensions: 1-1/2 inches by 15/16-inches; stop-mounted.

   c. Seals: Closed-cell extruded sponge neoprene.

5. Provide heavy-duty automatic acoustic drop-seal sound-stripping door-bottom unit with threshold of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar, and capable of operating to close a 1-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting on doors as follows:

   a. Housing: Extruded aluminum, 0.062-inch thick, with clear anodized finish on exposed surfaces.

   b. Seal: Closed-cell sponge neoprene.

   c. Mounting: Semi-mortise. Mount on stop-face of doors, except mount on binge-face of swing-in exterior doors.

Q. Thresholds

1. Thresholds for all exterior doors shall be supplied by custom entry door system manufacturer. All interior doors shall be provided with thresholds.

2. Metal: Extruded aluminum; custom satin brushed aluminum; US 26 finish.

3. Surface Pattern: Fluted tread, manufacturer's standard.

4. Provide countersunk stainless steel screws and expansion shields.

5. Width: five-inches wide and of length sufficient to span full width of rough openings; coped and scribed neatly at and around door frames.

6. Construction:

   a. Single-piece, complying with manufacturer's recommendations.

7. Profile: Provide manufacturer's unit which conforms to the minimum size and profile requirements specified.

8. Coordinate thresholds for full compatibility with recessed floor mounted closers.

9. Thickness: 1/2 inch minimum.

R. Offset Thresholds

1. Thresholds for custom entry door system doors shall be supplied by custom entry door system manufacturer. All doors shall be provided with thresholds of the types specified herein.
2. Metal: Extruded aluminum; custom satin brushed aluminum; US 26 finish.
3. Surface Pattern: Fluted tread, manufacturer's standard.
4. Provide countersunk stainless steel screws and expansion shields.
5. Width: 7-3/4 inches and 8-3/4-inches wide and of length sufficient to span full width of rough openings; coped and scribed neatly at and around door frames.
6. Construction:
   a. Single-piece, complying with manufacturer's recommendations.
   b. When threshold abuts a wall at the ends, provide straight ends substituted for mitered returns.
7. Profile: Provide manufacturer's unit which conforms to the minimum size and profile requirement specified.
8. Coordinate thresholds for full compatibility with recessed floor mounted closers and with 1/2-inch thick polyacrylate terrazzo at all locations of step down conditions.
9. Thickness: 1/2-inch minimum.

S. Silencers

1. Provide silencers for all door frames.
2. Provide pneumatic design that once installed, forms an air pocket to reduce noise.
3. Provide minimum of three per strike side of door jambs.

T. Stops

1. Stops shall be semi-automatic cast bronze extra heavy-duty floor mounted door holder, one per leaf.
2. Activation of holder accomplished by flipping engagement tongue forward. Release by firmly pushing door.

U. Sealants

1. Provide butyl rubber sealant complying with ASTM C920for use with thresholds.
2. Adhesives, sealants, and primers, shall comply with VOC limits established by City standards or other local restrictions, as applicable.

V. Hardware Finishes

1. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible. Reduce difference in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of finish hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch set for color and texture.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor, installer and architectural hardware consultant shall examine the substrate to receive finish hardware, and ascertain the conditions under which the work will be performed, and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the finish hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Preparation

1. Templates: Furnish finish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of finish hardware. Upon request, check the Shop Drawings of such other work, to confirm that adequate provisions are made for the proper installation of the finish hardware.

3.02 INSTALLATION

A. Mount finish hardware units at heights recommended in "Recommended Locations for Architectural Hardware" by Door and Hardware Institute, except as otherwise specified or required to comply with governing regulations.

B. Install each finish hardware item in compliance with the manufacturer's instructions and recommendations.

C. Set units level, plumb and true to line and locations. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Cut and fit threshold and floor covers to profile of door frames, and recessed floor mounted closers with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

F. Screw thresholds to substrate with No. 10 or larger stainless steel screws of the proper type for permanent anchorage.

G. Set thresholds in a bead of butyl rubber sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant before sealant cures to a firm set.

3.03 FIELD TESTING / QUALITY CONTROL

A. Provide a written field report, prepared by installer's architectural hardware consultant, identifying actual condition, location, manufacturer, and product designation for each item of finish hardware actually present on each door at the Site, including whether finish hardware is adjusted and operating properly. Compare actual units present with each item referenced to the approved Shop Drawings and Contract requirements.

B. Installer's architectural finish hardware consultant shall provide opinions to, and assist the Engineer in determining, acceptability of installation as work proceeds. All comments and discussions, conversations and meetings with the Engineer shall be included in written field report for submission to the Engineer for review and approval at completion of finish hardware installation.

C. As part of written field report to be submitted to the Engineer for approval, recommend remedial actions for work not in compliance with the Sections. No payment for remedial action shall be made until remedial recommendations and actions have been approved by the Engineer and incorporated into the Work.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide a Final Report on the actual finish hardware present on each door of the Work. Compare this field Report to approved Shop Drawings submittals and present to the Engineer with remedial recommendations. No payment for remedial actions shall be made until remedial recommendations have been approved by the Engineer and implemented by the Contractor.

B. Adjust and check each operating item of finish hardware and each door to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application.

C. Final Adjustment: Where finish hardware installation is made more than one month prior to Final Acceptance or occupancy of a space or area, return to the Work during the week prior to Final Acceptance or occupancy, and make a final check and

adjustment of all finish hardware items in such space or area. Clean and relubricate operating items as necessary to restore proper function and finish of finish hardware and doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.

D. Provide each manufacturer's authorized technical representative to instruct and train the City's personnel in proper adjustment and maintenance of finish hardware during the final adjustment of finish hardware.

E. Finish hardware which is blemished or defective will be rejected even though it was set in place before defects were discovered. Remove and replace with new finish hardware. Repair all resultant damage to other work.

F. Continued Maintenance Service: Approximately six months after the acceptance of finish hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the Project and readjust every item of hardware to restore proper function of doors and finish hardware. Consult with and instruct City's personnel in recommended additions to the maintenance procedure. Clean and lubricate operational items wherever required. Replace finish hardware items which have deteriorated or failed due to faulty design, materials or installation of finish hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the finish hardware.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 08 81 03 – GLASS, PLASTIC AND GLAZING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Furnishing all labor, materials, equipment, and appliances required for the complete execution of Work as shown on the Contract Drawings and specified herein.

B. Principal items of work include:

1. Insulated glass
2. Clear plate wire glass
3. Glazing clips, tapes, gaskets and compound

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 07 90 00 -- Joint Protection

1.04 REFERENCES

A.	NYCBC	--	New York City Building Code
B.	CPSC 16 CFR 1201	--	Federal Safety Standard for Architectural Glazing Materials
C.	ANSI Z97.1	--	Performance Specifications and Methods of Test For Safety Glazing Material Used in Buildings
D.	ASTM C1036	--	Standard Specification for Flat Glass
E.	ASTM E119	--	Standard Test Methods for Fire Tests of Building Construction and Materials

1.05 DESCRIPTION

A. System design requirements

1. Glass Sizes and Types

a. Each light of glass shall bear the manufacturer's label, showing kind, thickness, and quality, and the label shall not be removed until the Work has been inspected and approved by the Engineer.

b. All glass shall be the best quality of its respective kind, free from integral or surface defects and shall not be clouded, cracked, or broken.

2. Sustainable Design Requirements

a. Recycled Content of Glass: Postconsumer recycled content plus one-half of pre-consumer recycled content shall not be less than 10 percent.

b. Low Emitting Materials: Sealants and adhesives used on site and within the building's weatherproofing system shall meet the VOC content limits listed below or in the detail specifications.

1) Architectural Sealants: 250 g/L.

2) Sealant Primers for Nonporous Substrates: 250 g/L.

3) Sealant Primers for Porous Substrates: 775 g/L.

4) Multipurpose Construction Adhesives: 70 g/L

5) Structural Glazing Adhesive: 100 g/L.

3. Fire Rating

   a. Where Glass, Plastic and Glazing systems are used within a fire rated room, corridor, egress path, and as indicated in the Contract Drawings, those Glass, Plastic and Glazing systems shall maintain the fire rating of the location in which they are placed.

A. Project conditions

1. Perform glazing when ambient temperature is above 40 degrees Fahrenheit.

2. Perform glazing on dry surfaces only.

1.06 QUALITY ASSURANCE

A. In addition to complying with pertinent codes, regulations and safety standards, comply with the recommendations contained in the "Manual of Glazing" of the Flat Glass Marketing Association.

B. Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the referenced standards and the requirements of the Contract Documents, and who shall personally direct all installations performed under this Section.

C. Coordinate with the various glass, door, and window manufacturers to ascertain the proper type of glazing compounds to be used so that all design criteria are met and the required manufacturers' guarantees are not invalidated.

D. IGCC Certification-Insulating Glass Certification Program: Provide insulating glass units complying with requirements indicated which are permanently marked with certification label.

E. Glass thickness specified shall be considered as minimum values and thicker glass or wider insulating spaces, or both, may be required by door and window manufacturers in order to produce a product which meets the thermal requirements specified in other Sections. Secure and coordinate all requirements from each manufacturer prior to ordering or installing such items.

F. All glass shall be factory labeled on each pane and shall contain, as a minimum, the grade, type, and quality of glass and trademark. Glass without factory labels shall be considered unacceptable. After inspection and approval by Engineer, remove labels from all glass.

G. Check openings to verify that frames are plumb and true, square, and secure. Clean surfaces to be sealed; perform Work under satisfactory weather conditions; provide shelter and proper temperature.

H. Take field dimensions for cutting glass and fabricating units.

I. All glass sizes shall be determined by measuring the frames to receive the glass at the site and/or from guaranteed dimensions provided by the frame supplier. Glass sizes shall comply with the manufacturer's specified tolerances for each type of glass including cutting tolerance, minimum edge clearance, minimum face clearance, and cover on glass.

1.07 SUBMITTALS

A. Contractor shall submit the following to the Engineer for review and approval, in accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures.

1. Samples
2. Shop Drawings

B. Samples shall include:

1. Two 12" square pieces of each type of glass specified.
2. One bead, approximately 1/4 inch wide x 3 inches long of sealant, indicating color and set of cured material.

C. Shop Drawings shall include but not be limited to:

1. Complete layout and installation drawings and schedules with clearly marked dimensions.
2. Manufacturer's descriptive data of glass and glazing materials.
3. Recommended installation instructions.
4. Manufacturer's certification that the materials meet specification requirements.

D. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:
    a. Name of Product and Manufacturer.
    b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).
    c. The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.
    d. Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. For assemblies, include the percentage by weight that is considered regional.
2. VOC Reporting Form. Provide the following information:
    a. For all sealants and adhesives used on site and within the building’s weatherproofing system provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivered materials shall match approved samples in every respect. Deliver materials in the manufacturer's original unopened labeled containers, clearly

marked with their names and brands. Transport large panes of glass in vertical position with spacers to prevent contact between panes and edges.

B. Store glass in a dry, well-ventilated location at a constant temperature, maintained above dew point. Handling shall be kept to a minimum and all glass shall be protected from soiling, condensation, or moisture of any kind.

C. Glass delivered to the job Site with manufacturer's markings, or when markings are applied at the job, use either neutral or slightly acidic adhesive. In no case shall marking materials or adhesives be alkaline. Any staining of glass by alkaline material will be cause for rejection.

D. The edges of all tempered and insulating glass shall be protected from damage and edges shall not be modified in any way after the glass leaves the factory. Nipping of any glass to reduce size shall not be permitted.

E. All glass shall be delivered with manufacturer's labels showing type, thickness, and quality of material (and UL label as required). These labels shall not be removed until the glass is set and final approval has been secured.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Insulating Glass: The Contractor shall obtain from the insulating glass manufacturer and provide to the City a manufacturer’s warranty, in an acceptable and beneficial form, warranting to deliver without charge, a replacement for any unit, which develops material obstruction to vision due to film formation or dust collection on the interior glass surfaces resulting from failure of the hermetic seal other than through glass breakage for a period of 20 years from the date of Substantial Completion.

B. Laminated Glass: The Contractor shall obtain from the laminated glass manufacturer and provide to the City a manufacturer’s warranty, in an acceptable and beneficial form, warranting to deliver without charge, a replacement for any light of laminated glass, which develops edge separation or other defects, which materially obstruct vision through the glass for a period of five years from the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The products accepted as manufactured by:

1. PPG Industries, One PPG Place Pittsburgh, PA.
2. Libby - Owens – Ford, Toledo, OH.
3. Cardinal IG, Eden Prairie, MN.

4. Viracon, Inc., Owatonna, MN.
5. Guardian, Inc., Webster, MA.
6. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Unless otherwise specified, all glass shall conform to FS DD-G-451c. ASTM C1036 All product references are Viracon trade names. All substitutions shall perform equal to or better than products specified.

B. Insulating glass (unit type 1) shall be one and five-eighths (1-5/8) inches thick hermetically sealed units consisting of an outer light of 9/16 inch heat strengthened laminated panels with VH11-50 E Coating System" and an inner light of 9/16 inch thick heat strengthened laminated clear glass, each separated by 1/2 inch entrapped, dehydrated air, edges dual sealed and silicone second sealed. Each panel to have 0.060 clear polyisobutylene (PVB) inner layer.

1. Transmittance:
   a. Visible Light: 45%
   b. Solar Energy: 23%
   c. Ultraviolet: <1%
      1) (Ultraviolet defined as 300 to 380 nanometers (nm)
2. Reflectance:
   a. Visible Light-Exterior: 16%
   b. Visible Light-Interior: 13%
   c. Solar Energy: 21%
3. ASHRAE U-Value:
   a. Winter Nighttime: 0.30 Btu (hr. x sq. ft. x °F)
   b. Summer Daytime: 0.30 Btu (hr. x sq. ft. x °F)
4. Shading Coefficient: 0.39
5. Solar Factor (SHGC): 0.33
6. Relative Heat Gain: 85 Btu/hr x sqft

C. Insulated Glass with Obscure Translucent PVB unit (type 2). Same as type 1 except inboard lite to be 9/16 laminated glass with obscure PVB inner layer.

1. Transmittance:
   a. Visible Light: 45%
   b. Solar Energy: 23%
   c. Ultraviolet: <1%
      1) (Ultraviolet defined as 300 to 380 nanometers (nm)

2. Reflectance:
   a. Visible Light - Exterior: 16%
   b. Visible Light - Interior: 13%
   c. Solar Energy: 21%
3. ASHRAE U-Value:
   a. Winter Nighttime: 0.30 Btu (hr. x sq. ft. x °F)
   b. Summer Daytime: 0.30 Btu (hr. x sq. ft. x °F)
4. Shading Coefficient: 0.39
5. Solar Factor (SHGC): 0.33
6. Relative Heat Gain: 85 Btu/hr x sq ft

D. Wire Glass - Clear window glass with 3/4-inch square mesh welded wire reinforcing imbedded in glass. Clear plate wire glass shall be 1/4 inch thick, similar and equal to "Smooth Wire" as manufactured by Guardian, Inc., and shall be used for: Vision panels in doors or as indicated on the Contract Drawings.

E. Glazing Materials

1. Use a resilient, non-hardening glazing compound, capable of withstanding the climatic conditions at the Project Site, such as silicone or polysulfide sealants.
2. Secure recommendations from window and glass manufacturers as to the proper type of glazing compound, which should be used so as not to delaminate glass, stain materials, or otherwise create defects in the Work.
   a. Make exposed surfaces smooth, even and uniform in appearance. Slope glazing compound to readily shed water.
   b. Glazing compound for glazing metal sash, doors, etc., shall meet the requirements of ASTM E119 respectively for physical qualities and shall be as manufactured by:
      1) H.B. Fred Kuhls, Brooklyn, NY.
      2) Tremco Manufacturing Co., Beachwood, OH.
      3) Pecora Paint Co., Harleysville, PA.
      4) Gibbs and Hohman, Munster, IN.
      5) Or approved equal.
   c. Preformed vision strips and tape shall be used in conjunction with setting all glass in exterior windows and shall be similar and equal to Tremco vision strips and "Tremco 440" Tape as manufactured by:
      1) Tremco Manufacturing Co., Beachwood, OH.
      2) Or approved equal.

3. Tapes and vision strips shall be as selected from the manufacturer's standard products.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Sheet glass shall be cut and set with waves running horizontally.

B. All measurements and sizes for the Work shall be obtained and verified by the Contractor who shall be responsible for the correct and accurate fitting of all his work.

C. All glass shall be set in such manner as to avoid possibility of breakage.

D. Rabbets shall be thoroughly cleaned and shall have been prime coated before glass is set.

E. Glass shall be well bedded and back glazed and all surplus compound and markings shall be carefully removed from doors, sash and adjoining work, while still fresh. Compound shall be finished in true, even lines, neatly and smooth faced. All glass shall be set in strict accordance with the manufacturer's printed directions.

F. All glass when set and glazed shall be free from rattle and all exterior glazing shall be executed in such a manner that the Work will be watertight. Insulating glass shall be set in compliance with the manufacturer's instructions.

G. Glazing molds shall be removed and replaced in their correct locations in such a manner as not to mar molding or the screws securing same.

H. All glazing shall be done at the building after the Work into which glass is to be set has been installed. All openings shall be properly marked after being installed to show that the openings have been glazed.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Before and after installation, all Work shall be properly protected against damage.

B. On completion and prior to turning the project over to DEP, all metal work and glass shall be cleaned and left in perfect condition. Glass shall be washed outside and inside.

C. Make required adjustments.

D. Thoroughly clean all glass and mirrors just before final acceptance by DEP, or sooner if authorized by Engineer.

E. Remove excess glazing compound and foreign materials.

F. Replace broken or defective glass and hardened, uneven, defective or otherwise non-complying glazing compound.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment, and appliances required for the complete execution of the Work as shown on the Contract Drawings, specified in the Contract, and as specified herein.

B. The extent of louver Work is shown on the Contract Drawings and includes the following:

1. Individual louver openings where indicated.

2. Blank-off metal panels where required.

3. Bird screen or insect screen as required.

C. Remove sections of louver where indicated on the Drawings.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. AMCA 500 - Air Movement Control Association (AMCA) Louvers, Dampers, and Shutters, Test Method for

B. AA - The Aluminum Association Incorporated, Aluminum Standards and Data

1.05 DESCRIPTION

A. Structural Performance: Design, engineer, fabricate, and install metal louvers to withstand the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames and supports, noise, or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 pounds per square foot acting inwards or outwards.

2. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

a. Temperature Change (Range): 100 degrees Fahrenheit (55.5 degrees Celsius)

B. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturer's stock units of height and width indicated according to AMCA 500.

1.06 QUALITY ASSURANCE

A. Codes and Standards: All units shall conform to AA - Aluminum Standards and Data, latest edition.

1.07 SUBMITTALS

A. The following shall be submitted for review and approval by the Engineer.

1. Cut Sheets

2. Samples, including proposed finishes as specified herein

3. Shop Drawings

1.08 DELIVERY, STORAGE, AND HANDLING

A. Brace and support units to prevent deformation during delivery.

B. Factory wrap units with approved materials to protect finish during delivery and storage.

C. Handle units with care to prevent bending or scratching.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Airolite Co, Schofield, WI

B. Greenheck, Schofield, WI.

C. Airflex Corporation, Farmingdale, NY

D. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Double Drainable Fixed Louver:

1. Individual louver shall be Airflex Industrial Model No. FDD-6-SS or approved equal; fixed 45-degree, 6-inch-deep dual drainable storm proof blade of the following characteristics:

   a. Frames and blades shall be stainless steel 316 alloy .064" thick.

   b. Fasteners: Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

      1) Use types, gages and lengths to suit unit installation conditions.

      2) Use Philips flat-head machine screws for exposed fasteners unless otherwise indicated.

   c. Anchors and inserts of type, size, and material required for type of loading and installation indicated. Use non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installation and elsewhere as required for corrosion resistance.

   d. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2. Manufacturer to submit test data on four feet x four feet louver units. Test data shall show the following results at 1100 fpm free area velocity.

Minimum Free Area	Maximum Pressure Drop	**MAXIMUM WATER PENETRATION**
7.32 sq. ft.	0.24 in	0.005 oz.
0.678 m	6.10 mm	1.53 g

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Finish

1. Exposed sides of all stainless steel components shall be Airflex Industrial finish A1221 Glass Bead or approved equal to match finish of windows, as per the approved submittal of the finish sample.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Anchor louver frames using stainless steel bolts into holes drilled and tapped in sub-frames or with strap anchors to masonry in accordance with the manufacturer's approved directions.

B. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.

C. Mount bird screens of all louvers unless indicated otherwise on inside face with clips, machine screw into frames. Screws shall be stainless steel.

D. Verify size, location, and placement of continuous louvers and individual louver units prior to fabrication wherever possible. Coordinate field measurement and shop assembly to minimize field adjustment. It is important to recognize that both fabrication and installation be done by the same company in order to achieve the quality required.

E. Locate and place louver units plumb, level, and in proper alignment.

F. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

G. Form closely fitted joints with exposed connections accurately located and secured.

H. Provide perimeter reveals and openings of uniform width for sealants and joint fillers as indicated.

I. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of

corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit or provide new units.

J. Install concealed gaskets, flashings, joint fillers and insulation as louver installation progresses where required to make louver joints weather-tight.

K. Protect louvers and vents from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

L. Restore louvers and vents damaged during installation and construction period so that no evidence remains of correction work. If results of restoration are unsuccessful, remove damaged units and replace with new units.

M. Do all cutting and fitting required for the installation in a neat manner.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Upon Completion, remove any and all protective coatings and clean off all parts of the Work in accordance with Contract Documents.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 08 92 00 – LOUVERED ENCLOSURES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment, and appliances required for the complete execution of the Work as shown on the Contract Drawings, specified in the Contract, and as specified herein.

B. The extent of the louvered enclosures is shown on the Contract Drawings and includes the following:

1. Fixed sections of louvered fence

2. Matching louvered gates that open to the required widths and in the locations shown on the Contract Drawings, which can be secured closed.

C. Removal sections of fences and gates, where indicated on the Contract Drawings.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Special Warranty Provisions / Guarantee Periods	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A.	NYCBC	-	New York City Building Code
B.	AMCA 500	-	Air Movement Control Association (AMCA) Louvers, Dampers, and Shutters, Standard Test Method for
C.	ASTM B209	-	Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for
D.	ASTM B221	-	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, Standard Specification for
E.	AA	-	The Aluminum Association Incorporated, Aluminum Standards and Data

1.05 DESCRIPTION

A. Structural Performance: Design, engineer, fabricate and install metal louvers to withstand the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames and supports, noise, or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 pounds per square foot acting inwards or outwards.

2. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

    a. Temperature Change (Range): 100 degrees Fahrenheit (55.5 degrees Celsius)

1.06 QUALITY ASSURANCE

A. Codes and Standards: All units shall conform to AA - Aluminum Standards and Data, latest edition.

1.07 SUBMITTALS

A. The following shall be submitted for review and approval by the Engineer.

1. Cut Sheets

2. Samples, including proposed finishes as specified herein

3. Shop Drawings

1.08 DELIVERY, STORAGE, AND HANDLING

A. Brace and support units to prevent deformation during delivery.

B. Factory wrap units with approved materials to protect finish during delivery and storage.

C. Handle units with care to prevent bending or scratching.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The Airolite Co, Schofield, WI.

B. Hercules Custom Iron, LLC, Walkersville, MD.

C. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Louvered Enclosure:

1. Louvers of the enclosure should be composed of sightproof, storm proof blades of the following characteristics:

a. Frames and blades shall be 6063-T6 aluminum.

b. Fasteners: Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1) Use types, gauges, and lengths to suit unit installation conditions.

2) Use Philips flat-head machine screws for exposed fasteners unless otherwise indicated.

c. Anchors and inserts of type, size and material required for type of loading and installation indicated. Use non-ferrous metal or hot-dip galvanized anchors and inserts..

d. Components should be shaped to shed precipitation and other liquid coming from either side.

e. The edges and both faces of the louvered enclosure panels should all be finished to withstand exposure to the elements.

f. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Finish

B. Enclosure components shall be factory finished in the color indicated by the Architect, as per the approved submittal of the finish sample.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Anchor louvered enclosures to concrete slabs in accordance with the manufacturer's approved directions.

B. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.

C. Verify size, location, and placement of louvered enclosures prior to fabrication wherever possible. Coordinate field measurement and shop assembly to minimize field adjustment. It is important to recognize that both fabrication and installation should be done by the same company in order to achieve the quality required.

D. Locate and place louver units plumb, level, and in proper alignment.

E. Form closely fitted joints with exposed connections accurately located and secured.

F. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit or provide new units.

G. Protect louvered, enclosures, and gates from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louvered enclosure manufacturer. Remove protective covering at time of Substantial Completion.

H. Restore louvered enclosures and gates damaged during installation and construction period so that no evidence remains of correction work. If results of restoration are unsuccessful, remove damaged units and replace with new units.

I. Do all cutting and fitting required for the installation in a neat manner.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Upon Completion, remove any and all protective coatings and clean off all parts of the Work in accordance with Contract Documents.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Gypsum board systems as specified herein include but are not limited to: interior wallboard for partitions, metal stud partitions, furring, and trim and appurtenances.

B. Gypsum board systems shall be provided as indicated on the Contract Drawings, specified herein, or as required otherwise for a complete installation.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 13.01 - Galvanizing

B. Section 09 91 00 - Painting

1.04 REFERENCES

A. ASTM C1396 - Standard Specification for Gypsum Board

B. ASTM A580 - Standard Specification for Stainless Steel Wire

C. ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board

G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold On the Surface of Interior Coatings in an Environmental Chamber

J. New York City Building Code

1.05 DESCRIPTION

A. System Design Requirements

1. Interior Moisture- and Fire-Resistant Wallboard: Shall meet product standard ASTM C1396 and installation standard ASTM C840; fire resistance classified by UL according to ASTM standards; recycled content on a dry-weight basis certified in accordance with ISO 14021.

B. Sustainable Design Requirements

1. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 45 percent.

2. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

3. Recycled Content of Sound Attenuation Blankets: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 45 percent.

4. Regional Materials: When possible, gypsum panel products shall be manufactured within 500 miles of Project Site from materials that have been extracted, harvested, or recovered within 500 miles of Project Site.

5. VOC Content: Products applied on Site and within the building's weatherproofing system shall comply with VOC limits of authorities having jurisdiction and the following VOC limits of when calculated according to South Coast Air Quality Management District (SCAQMD) Rule 1168:

   a. Gypsum Board and Panel Adhesives: 50 g/L.

   b. Architectural Sealants: VOC not more than 250 g/L.

C. Project-specific system / design requirements under the work of this Section will be provided in the Contract (if necessary) to update the requirements made herein or to supplement requirements made on the Contract Drawings.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: All gypsum board system Work shall comply with fire-resistance ratings as shown, and as required by governing authorities and the New York City Building Code and shall be in accordance with the following requirements:

1. The Office of Technical Certification and Research (OTCR) of the New York City Department of Buildings: Where, in order to be incorporated into the Work, a particular item or product system specified by Engineer requires acceptance by the New York City Commissioner of Buildings, Contractor shall ensure that the product manufacturer has obtained such approval, without additional expense to DEP, and in providing DEP with an approved certified copy from the Approved Independent Agency, for the item or product system which shall be submitted to Engineer as part of the Shop Drawing approval process. Contractor may submit, in place of products specified by Engineer, products which are "equal" in all ways to the product specified that is NYC code prescribed or alternate the code. Such "or approved equal" product submissions shall not change the requirements of these Sections as to performance, required features, or properties, as determined by Engineer, and shall not require additional compensation to Contractor or additional expense to DEP. Final acceptance of "equal" is at the sole determination of Engineer.

B. In those instances where the Commissioner of Buildings requires a certificate of compliance from the manufacturer or producer certifying that the item or product system was tested and is equivalent to material of the same kind and quality regularly being manufactured by such manufacturer or producer, Contractor shall provide all such certificates to the Commissioner of Buildings without additional expense to DEP.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to, catalog cuts, drawings, and reference materials.

1. Product Data: The Contractor shall submit:

a. Copies of specifications, installation instructions, and general recommendations from the gypsum board systems manufacturers, for each type of product.

b. Manufacturer's data substantiating that the materials comply with the requirements shall be included.

2. Sustainable Design Submittals:

a. Environmental Materials Reporting Form (EMRF) Recycled Content and Regional Materials. Provide the following information:

1) Name of Product and Manufacturer.

2) Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

3) The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

4) Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. For assemblies, include the percentage by weight that is considered regional.

3. VOC Reporting Form. Provide the following information:

a. For all adhesives and sealants used on site, provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. All materials shall be stored in a dry, enclosed area, off the ground and away from all possible contact with water, ice, or snow.

3. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled carefully in order to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work.

3. Materials shall be handled in such a manner so as to prevent inclusion of foreign materials.

4. Packages or containers shall not be opened until all necessary preparatory work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Georgia-Pacific Gypsum, Atlanta, GA;

B. National Gypsum Company, Charlotte, North Carolina;

C. American Gypsum, Dallas, TX;

D. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Gypsum wallboard shall be synthetic wallboard made using the output of the Flue Gas Desulphurization (FGD) process from fossil-fuel burning power plants.

B. Non-synthetic gypsum board shall be made with 100% recycled paper facings.

C. Gypsum wall board shall comply with ASTM C 1396.

D. Gypsum wallboard shall be of the tapered type, Sheetrock Firecode Core 5/8-inch thick, Type X gypsum panels, 4 feet wide, and of lengths indicated or required.

E. Metal materials and accessories shall be galvanized in accordance with Section 05 05 05 13.01 - Galvanizing unless indicated otherwise.

F. Studs and tracks shall comply with ASTM C645 and be 18-gauge steel 3-5/8-inch width for gypsum board, with studs spaced at 16-inch centers. Studs for tile backer board shall be of size recommended by the manufacturer.

G. Furring Channels and Clips: Furring channels shall be hat type, 7/8-inch by 2-1/2-inch spaced on 16-inch centers, ASTM C645. Furring channel clips shall be as recommended by the manufacturer to fasten furring channels to runners.

H. Screws and Fasteners: ASTM C1002 Type "S-12" coated drywall screws shall be used for attaching gypsum wallboard in lengths 3/8-inch greater than the total thickness of wallboard being fastened to the framing. Size and type of screws for attaching metal door frames and runners, metal trim and the like shall be as recommended by the gypsum wallboard manufacturer.

I. Tie wire shall be of 18-gauge stainless steel, ASTM A580.

J. Runners shall be cold-rolled 1-1/2-inch channels weighing not less than 475 pounds per 1,000 lineal feet, ASTM C645.

K. Joint Treatment: Joint compound, perforated tape, and taping compound shall be as recommended by the manufacturer for intended use of the gypsum board. Comply with ASTM C475.

L. Adhesives, sealants, and primers shall comply with VOC limits and be as recommended by the gypsum wallboard manufacturer.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive gypsum board systems are properly prepared and completed to final elevations.

B. Protection: In cold weather, during gypsum wallboard application and joint finishing, temperatures within the building shall be maintained in the range of 55 to 70 degrees Fahrenheit and adequately ventilated to remove excess moisture.

3.02 INSTALLATION

A. General: Gypsum Wallboard System shall be installed in accordance with the manufacturer's recommendations and approved shop drawings.

B. Wall Furring and Framing Installation: ASTM C754, Furring channels, and runners for metal studs shall be accurately aligned and secured to the structure at intervals of not more than 24-inch centers, and additional fasteners shall be provided not more than two inches from the end of each length. Metal studs shall

be crimped into runner tracks at top and bottom, both sides, for friction fit with 1/4-inch deflection clearance at the top. Studs shall be securely fastened at ends of partitions, openings, and intersections to runners with screws through both flanges of the stud and runner. Adequate provisions shall be provided for deflection, expansion, and contraction between structural members and partitions. Additional studs, reinforcing channels, accessories, and total installation shall be as recommended by the manufacturer. Double studs shall be used at free ends of partitions.

C. Wallboard Installation:

1. Comply with ASTM C840 or gypsum board manufacturer's written recommendations, whichever are more stringent..

2. Wallboard shall be installed in strict compliance with the manufacturer's printed specifications and recommendations for metal framed dry wall construction, including fireproofing, gypsum wallboard erection, and application of joint system, accessories and adhesives. Gypsum wallboard surfaces shall be isolated with control joints at the following locations:

   a. Where partitions abut a structural element or dissimilar wall material.

3. Gypsum boards shall be fastened to walls vertically. Joints shall not occur on opposite sides of a partition on the same stud.

4. All gypsum wallboard surfaces shall be sanded as necessary to provide a flat smooth surface ready for painting or application of other materials.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Protection

1. All components of the Work shall be protected from detrimental weather and damage until construction operations are completed and acceptable to Engineer.

2. Work which cannot, for reasons acceptable to Engineer, be covered with complete construction system before onset of weather detrimental to the Work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.

3. Gypsum board systems shall be protected from all damage and abuse until Final Acceptance by DEP.

B. Adjustment

1. System components which are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or by detrimental weather shall be immediately replaced with undamaged material in compliance with the requirements herein and properly protected as specified.

C. Cleaning

1. After installation, gypsum board systems shall be cleaned and left in a neat condition, ready to be painted as specified in Section 09 91 00 - Painting. Cleaning shall be performed using materials and processes as recommended by the manufacturer.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Ceramic tile as specified herein shall include, but not be limited to, ceramic floor tile, ceramic wall tile, matching base and trim, and appurtenances.

B. Ceramic tile items shall be provided where shown on the Contract Drawings, specified in the Contract, or as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. TCA - Installation Handbook: Tile Council of America, Inc.

B. ANSI A108.1 - Installation of Ceramic Tile , American National Standard Specifications for

C. ANSI A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar, American National Specification for

D. ANSI A108.10 - Installation of Grout in Tile Work

E. ANSI A118.1 - Dry-Set Portland Cement Mortar

F. ANSI 118.3 - Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy and Water-Cleanable Tile Setting Epoxy Adhesive

G. ANSI A118.6 - Ceramic Tile Grouts

H. ANSI A137.1 - Ceramic Tile

1.05 DESCRIPTION

A. Environmental Requirements: The ambient temperature of the area in which the Work occurs shall be at least 60 degrees Fahrenheit and rising. A minimum 60 degrees Fahrenheit ambient temperature shall be maintained without interruption while the Work is being done, and for at least three days after completion of the Work.

1.06 QUALITY ASSURANCE

A. All Work described in this Section shall be in conformance with the latest edition of the TCA Handbook for Ceramic Tile Installation.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to, catalog cuts and reference materials.

1. Product Data: The Contractor shall submit:

a. Copies of specifications, installation instructions and general recommendations from the ceramic tile manufacturer, for each type of ceramic tile product.

b. Manufacturer's data substantiating that the materials comply with the requirements shall be included.

2. Samples:

a. Samples of floor and wall tile shall be submitted for color selection.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. All materials shall be stored in a dry, enclosed area, off the ground and away from all possible contact with water, ice, or snow.

3. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the Site before being incorporated into construction systems.

C. Handling of Materials:

1. Materials shall be handled carefully in order to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work.

3. Materials shall be handled in such a manner so as to prevent inclusion of foreign materials.

4. Packages or containers shall not be opened until all necessary preparatory Work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daltile, Dallas, TX

B. MSI Surfaces, Orange, CA;

C. Marazzi, Dallas, TX

D. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Floor Tile: Ceramic floor tile shall be standard grade, dust-pressed, unglazed porcelain type, cushion edged, and paper back-mounted or paper face-mounted. Tiles shall be approximately 2-in. by 2-in. by 1/4-in. thick. Colors will be selected

by Engineer from manufacturer's full range. Tile shall show no staining when subjected to attack by N/10 acids, alkalies, or organic.. Surface bull nose to match the floor tile shall be provided to finish the floor where required at finished openings. All floor tile shall be in conformance with ANSI A108.1 and A137.1.

B. Bond Coat: Ceramic tile shall be set with dry-set mortar conforming to ANSI A118.1.

C. Mortar Bed: Where shown on the Contract Drawings or specified in the Contract, mortar bed shall be in accordance with ANSI A108.1A.

D. Mortar Bed Bond Coat: Where shown on the Contract Drawings or specified in the Contract, mortar bed bond coat shall be a Portland Cement slurry.

E. Latex Grout: Latex Portland Cement grout shall conform to ANSI A118.6.

F. Epoxy Grout: Epoxy grout shall conform to ANSI A118.3.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive ceramic tile materials are properly prepared and completed to final grades and elevations.

3.02 INSTALLATION

A. Thinset Method: Tile shown to be installed by the Thinset Method, shall be installed as follows:

1. Ceramic tile shall be installed by the "dry set mortar" method and shall be in accordance with the TCA Handbook for Ceramic Tile Installation Method No. F113 for floors, Method No. W202 for masonry or concrete walls, and Method No. W243 for gypsum board walls. Tile shall be grouted using latex Portland Cement grout with latex additives. Tile shall be installed in compliance with ANSI A108.5 and A108.10.

B. Base shall be as indicated and shall be installed by the Square method, Thin-lip method, or Flush method as indicated in the TCA Handbook for Ceramic Tile Installation. Method shall be as specified in the Contract.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjustment

1. System components which are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Sections and properly protected as specified.

B. Protection

1. All components of the Work shall be protected from detrimental weather and damage until construction operations are completed and acceptable to Engineer.

2. Work which cannot, for reasons acceptable to Engineer, be covered with complete construction system before onset of weather detrimental to the Work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent Work.

3. Ceramic tile work shall be protected from all damage and abuse from all other Contractors and installers involved in the Work until Final Acceptance by DEP. All floor and wall surfaces shall be protected from abrasion or the adherence of any foreign material by maintaining covers when necessary. The wheeling of materials or placement of concentrated loads shall not be allowed on finished floors.

C. Cleaning

1. After installation, ceramic tile shall be cleaned and left in a neat condition. Units shall be cleaned using materials and processes as recommended by the manufacturer.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 09 91 00 – PAINTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Painting, as specified herein, shall include, but not be limited to, preparation of surfaces, shop painting of items furnished, and field painting of structures, piping, conduit, ducts and equipment, and marking of piping and electrical conduits.

B. Painting shall be provided as shown on the Contract Drawings, specified herein or in the Contract, or as required for a complete installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	13
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	13
3.01	Examination / Preparation	13
3.02	Application	14
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	18
3.05	Adjusting / Protection / Cleanup	19

D. The following schedule, attached after the End of Section designation, is a part of this Section:

1. Material Paint Schedule

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 05 97 - Identification for Process Equipment.

1.04 REFERENCES

A. SSPC - The Society of Protective Coatings (formerly of Steel Structures Painting Council)

1. SSPC-SP 1 Solvent cleaning
2. SSPC-SP 6 Commercial blast cleaning
3. SSPC-SP 10 Near white cleaning
4. SSPC-SP 2 Hand tool cleaning
5. SSPC-SP 11 Power tool cleaning to bare metal
6. SSPC-SP 15 Commercial grade power tool cleaning
7. SSPC-SP 16 Brush off Blast Cleaning of Non Ferrous Metals

B. ASTM - American Society for Testing Materials

1. ASTM D3359 - Measuring Adhesion by Tape Test
2. ASTM D16 - Terminology Relating to Paint, Varnish, Lacquer, and related Products

C. NSF - National Sanitation Foundation Standards

D. ISO - International Organization for Standardization

1. ISO 14025 – Requirements and Guidelines for Type III Environmental Labels and Declarations.
2. ISO 14044 - Requirements and Guidelines for life cycle assessment (LCA) studies and life cycle inventory (LCI) studies.

E. EPD - Environmental Product Declaration

1. A third-party verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

1.05 DESCRIPTION

A. Safety Requirements

1. All painting materials specified herein, and ingredients of coatings containing substances that are potentially toxic or hazardous, shall be shipped with warning labels. These products shall be applied in strict conformance with the safety requirements of the following:

a. Manufacturer

b. National Paint and Coatings Association (NPCA)

c. Society of the Plastics Industry (SPI)

d. Manufacturing Chemist Association (MCA)

e. Society of Protective Coatings (SSPC)

f. United States Government Occupational Safety and Health Administration (OSHA)

g. Health and Safety Requirements of the State of New York (PESH-Public Employees Safety and Health)

h. Health and Safety Requirements of the City of New York (COSH-Citywide Office of Safety and Health)

B. Environmental Requirements

1. Weather:

a. Air and surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.

b. Surface Temperature: Minimum of five degrees Fahrenheit (three degrees Celsius) above dew point.

c. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.

d. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog or mist.

e. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.

2. Ventilation

a. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D102.

3. Dust and Contaminants:

a. Schedule coating Work to avoid excessive dust and airborne contaminants.

4. Protect Work areas from excessive dust and airborne contaminants during coating application and curing.

1.06 QUALITY ASSURANCE

A. Paint Quality Assurance Records

1. The following information shall be recorded for every paint project and submitted to the Project-Manager:

a. Date

b. Shift

c. Part Temperature

d. Dew Point

e. Paint Batch Number/s

f. Mixing Time for Each Part and the Combined Parts of a Paint System

g. Pot Life

h. Curing Time of Primer and Finish Layers

i. Paint thickness measurements (DFT)

j. Holiday Test Results and Repair Data

k. Peel Test Results and Repair Data

l. Foreman or Supervisor's Signature

B. Test Surfaces

1. The Contractor shall paint certain areas of concrete and other surfaces, where directed, using approved coatings for use by the Engineer for comparisons with coating systems applied during the progress of the Work.

2. Such coated areas shall not be subsequently painted during the entire period of construction or during the period one-year after the date of Final Acceptance.

3. At or about one year after Final Acceptance, the test surfaces shall be inspected by DEP for any deterioration such as cracks, blisters, flakes, and excessive chalking.

4. The Contractor shall supply all material and labor and shall perform any remedial Work on all such deteriorated surfaces using the coating system represented by the test surface at no additional cost to DEP.

C. Painting Requirements

1. General: The Contract does not specify the surface treatment for every individual part of the Work, however this Contract shall be provided with a complete painting job throughout the Work as specified herein. All items customarily or specified to be shop painted shall be primed and finished in the shop. Field painting will not be allowed unless requested in writing to the Engineer, and written consent is given by the Engineer. In general, only areas that are to be field welded are not to be painted until field erected.

2. Manufacturer's Standard Finished Items: The following items shall be furnished with the manufacturer's standard prime and finish coats applied in the shop: pumps, motors, gears, gear housings, air compressors, wall

fans, temperature control and instrument panels, process air blowers, engines, filters, strainers, air dryers, meters, gas boosters, gas turbines, generators, panelboards, transformers, boilers, condensing units, water chillers, cooling towers, condensers, heat exchangers, humidifiers, air handling units, sound attenuators, air conditioning and dehumidification units, convector cabinets, unit heaters, enclosures for finned tube radiators, cabinet heaters, boilers, wood seats, lockers, metal toilet partitions, metal urinal screens, aluminum fascia, motor control centers, aluminum light standards, and hoisting equipment. Steel reinforcing bars for concrete shall be coated in accordance with the Contract. When powder coatings are required by the Contract, the powder coatings shall be in accordance with the requirements of the manufacturer of the item.

3. Painted Items: The following items shall be painted as specified herein: , structural steel and wrought metals, composite metal floor deck, pipelines, hangers and supports, sluice gates, pumps and pumps parts, valves, valve and sluice gate operators and stands, guard housings, air filter equipment, effluent strainers, heat exchangers, air receivers, tanks, air silencing equipment, storage tanks, gas domes, sediment tanks, steel stair framing, steel lintels, hollow metal doors and frames, gypsum wallboard, interior concrete block, interior concrete walls, columns, beams and ceilings, covering over insulation on piping, electrical conduit systems, small piping and copper tubing, ducts, covering over ducts, and PVC piping, valves, and fittings.

4. Unpainted Items: The following items shall not be painted, unless otherwise specified: registers, grilles, dampers and linkage, fire sprinklers, name and identification plates and tags, floor gratings, brass pipe and fittings, brass valves, stainless steel, wood, stop log panels, spray-on fireproofing steel to receive spray-on fireproofing, surfaces to receive field welding, and faying surfaces of high strength bolted connections.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval by the Engineer. Submittals shall include, but not be limited to:

1. Catalog cuts and reference materials.

2. Color Chart: The Contractor shall submit the manufacturer's standard color chart for color selection for painting of items other than process piping, valves, pipe line equipment, pump casings, blowers, and other mechanical equipment and their drive units, all of which shall be in conformance with the "BACKGROUND COLOR" of the General Color Code specified in Section 40 05 97 – Identification for Process Equipment.

3. Paint Samples:

a. Two one-quart samples of each required kind of paint material, or the ingredients thereof which are to be mixed on the job.

b. Samples shall be labeled and shall include the certificate of the manufacturer stating the actual percentages by weight and volume of all ingredients entering into the mixture.

c. Upon request, further samples shall be provided as the Work progresses.

d. Painting materials shall not be applied without written approval of samples by the Engineer.

4. Painted Surface Samples:

a. Upon request, duplicate samples of the results obtained by painting and finishing various materials on the Work shall be submitted. Such samples, and the approved paint applied thereto, shall be applied in strict conformance with these Sections.

b. Finished areas shall be considered adequate for the purpose of determining the quality of the Work. All painting work shall be performed in a quality equal to the approved samples.

c. Where equipment is customarily shipped with a standard finish, samples of the proposed color and finish shall be submitted for approval prior to shipping.

5. Certification:

a. Affidavits from the manufacturer certifying that materials furnished conform to the requirements specified.

b. And that paint products have been checked for compatibility.

6. Immersion Certification:

a. Affidavits from the manufacturer certifying that coatings in immersion service contain no water-soluble solvents or corrosion inhibitive (active) pigments with slight water solubility.

7. List of Paints:

a. A list of paint products with mil thickness and solids by volume, including all paint applied in the shop and in the field. The list shall be in accordance with the requirements of this Section and the recommendations of the paint manufacturer.

8. Applicator’s Quality Assurance:

a. Submit list of a minimum of five completed projects of similar size and complexity to this work. Include for each project:

1) Project name and location

2) Name of owner

3) Name of contractor

4) Name of engineer

5) Name of coating manufacturer

6) Approximate area of coatings applied

7) Date of completion

9. Warranty:

a. Submit manufacturer's standard warranty.

10. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declarations (EPDs) conforming to ISO 14025 and ISO 14044.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: All products and materials shall be delivered, stored, and handled as specified in Contract Documents and as follows:

B. Delivery and Storage: All paint materials delivered and stored at the Site shall be from the approved manufacturer only.

C. Packaging and Labeling: Paints, stains, varnish, or ingredients of paints to be used on the job shall be properly prepared, packed, and labeled. All materials shall be delivered to the Site in original, unbroken containers bearing the manufacturer's printed labels, which shall specify the following:

1. Project and Contract No.

2. Name of manufacturer

3. Address of manufacturer

4. Generic name of paint or ingredients

5. Brand and trademark

6. Schedule letter as listed herein

7. Percent solids by volume

8. Net quantity

9. Date of manufacturer

10. Date packed

D. Storage: Painting materials shall be stored at the Site in manner and place which shall be in accordance with applicable codes and regulations, and in accordance with manufacturer's instructions. The storage space shall be kept clean at all times. Every precaution shall be exercised to eliminate fire hazards.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Standards of Quality: Proprietary protective coatings included herein by brand name or trademark are given solely as standards of quality and for bidding purposes and do not preclude the use of an approved equivalent.

B. Latest Products: Unless specified otherwise, the proprietary protective coatings of the manufacturer's latest products in regular production on the date of receipt of order shall be provided.

C. Equivalents: Equivalent products shall be of a standard, regularly produced product of a manufacturer. Equivalent products shall be submitted on their applicable published printed literature that states the generic type, instructions for use, solids by volume, application rates, and chemical components of vehicles and solids. Equivalent products shall be accompanied by a list of projects where each of the coatings has been used on new construction and has rendered satisfactory service for at least three years. Should the manufacturer's literature of the product being offered call for higher film thickness, the greater film thickness shall be applied, and the submitted schedule shall so state.

D. Paints shall be as manufactured by the following manufacturers:

1. Tnemec Company, Inc., Kansas City, MO.
2. Sherwin Williams, Cleveland, OH.
3. International Paint, Houston, TX.
4. Carboline Company, St. Louis, MO.
5. PPG Amercoat, Little Rock, AR.
6. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Compatible shop and field coats shall be provided.
2. All coats of paint for any particular surface shall be from the same manufacturer.
3. Paint shall be of approved color as selected from the manufacturer's standard range of colors.

4. The Contractor shall submit proposed modifications to the specified painting systems for the Engineer's approval prior to use.

5. Paints containing lead or manganese driers shall not be submitted.

B. Classification of Paints: Alphabetical designations have been used in the following list to classify/group acceptable paints by the type and quality of materials desired. Equivalent material from the manufacturers named above or from other approved manufacturers may be used in any of these paint groups in accordance with the procedures for substitution. Refer to the “Material Painting Schedule”, attached after the “End of Section” designation, for applicability of these paint groups.

CLASSIFICATION OF PAINTS			
Paint Group	**Product Name and Number**	**Volume Solids %**	**Dry Film Thickness Mils per Coat**
A	**Tnemec:** Series V69 Hi-Build Epoxoline II	69	3.0-5.0
	Carboline: Carboguard 60/61 or Carboguard 635 or Carboguard 890 Series	72 65 75	4.0-8.0 4.0-6.0 4.0-8.0
	Sherwin Williams: Macropoxy 240	72	2.0-4.0
	International Paint: Integrated 345 or Devran 224V	70/77	3.0-4.0 (typically 4.0-6.0)
	PPG: Amerlock 2/400	85	4.0-8.0
B	**Tnemec:** Series V140-44 BR Pota-Pox Plus	69	4.0-6.0
	Carboline: Sanitile 120	38	1.0-2.0
	Sherwin Williams: Dura-Plate 235 (Waste Water)	68	3.0-5.0
	International Paint: Interseal 670 HS or Bar Rust 233HS	82/80	3.0-6.0 (typically 4.0-8.0)
	PPG: Amerlock 2/400	85	4.0-8.0
C	**Tnemec:** Series 1095 Endura-Shield	68	2.0-3.0
	Carboline: Carbothane 134 Series or Carbothane 134WB	70 50	2.0-3.0 2.0-3.0
	Sherwin Williams: Hi Solids Polyurethane 250 or Sherloxane 800	63 90	3.0-5.0 4.0-6.0
	International Paint: Interthane 990V or Devthane 379	71/63	2.0-3.0
	PPG: Pithane Ultra	70	2.0-3.0
D	**Tnemec:** Series V69 Hi-Build Epoxoline II	69	3.0-5.0
	Carboline: Carboguard 61 or Carboguard 691 or Carboguard 635 Series	72 80 65	4.0-8.0 4.0-20.0 4.0-8.0
	Sherwin Williams: Macropoxy 646	72	4.0-6.0
	International Paint: Interseal 670HS or Bar Rust 233H/236	82	3.0-6.0
	PPG: Amerlock 2/400	85	4.0-8.0
E	**Tnemec:** Series 90-97 Tnemec-Zinc	63	2.5-3.5

CLASSIFICATION OF PAINTS			
Paint Group	**Product Name and Number**	**Volume Solids %**	**Dry Film Thickness Mils per Coat**
	Carboline: Carbozinc 859 Series or Carboguard 890 Series or Carboguard 60/61	66 75 72	3.0-10.0 4.0-10.0 4.0-10.0
	Sherwin Williams: Corothane I Galvapac	67	2.5-3.5
	International Paint: Interzinc 52	59	3.0-5.0 (typically 2.0-3.0)
	PPG: Amercoat 68HS	70	2.5-5.0
F	**Tnemec:** Series 54 Envirofill Masonry Filler	68	As Required
	Carboline: Sanitile 100 Block Filler or Carbocrylic 3350	54	As Required
	Sherwin Williams: Heavy Duty Block Filler (dry) Kem Cati –Coat Epoxy Filler/ Sealer	50 72	8-10 10-20
	International Paint: Devran 224 or Intercrete 4820	77/NA	As Required
	PPG: Perma-Crete 4-100XI	55	8.0-11.0
G	**Tnemec:** Series 151 Elasto-Grip	17	1.0-1.5
	Carboline: Galoseal WB	31	0.5-1.0
	Sherwin Williams: Pro-Mar 200 Zero VOC / Primer	26	1.0-2.0
	International Paint: Intercryl 520	44	1.0-2.0 (typically 2.0-3.0)
	PPG: Seal Grip 17-921XI	28	1.6
H	**Tnemec:** Series 1026	43	2.0-3.0
	Carboline: Sanitile 155	38	2.0-3.0
	Sherwin Williams: Pro-Mar 200 Zero VOC Series Eg-Shel (dry wall) or Pro Industrial DTM Acrylic Gloss (pipe insulation)	42 40	1.5-2.0 2-4
	International Paint: Intercryl 530/WB	35	1.5-2.0 (typically 2.0-3.0)
	PPG: Speedhide Interior Latex 4510XI	37	1.5

CLASSIFICATION OF PAINTS			
Paint Group	**Product Name and Number**	**Volume Solids %**	**Dry Film Thickness Mils per Coat**
I	**Tnemec:** Series V140-AA83 Pota-Pox Plus	82	4.0-6.0
	Carboline: Carboguard 691/ Phenoline Tank Shield	80-100	4.0-20.0
	Sherwin Williams: Macropoxy 646 PW	72	4.0-6.0 (2-4 as concrete primer)
	International Paint: Interseal 670HS or Bar Rust 233H	82/80	4.0-6.0 (typically 4.0-8.0)
	PPG: Amerlock 2	85	4.0-8.0
J	**Tnemec:** Series 141 or Series 435	82 100	1.0-3.0 20-30
	Carboline: Carbozinc 621 / Plastite 4503 / Carboguard 691	80-100	4.0-10.0
	Sherwin Williams: Duraplate 235	68	3.0-5.0
	PPG: Amerlock 2	85	4.0-8.0
K	**Tnemec:** Series 141 or Series 435	82 100	1.0-3.0 20-30
	Carboline: Reactamine 760 Series Plasite 4550S	100 100	20.0-100.0 20.0-60.0
	Sherwin Williams: PolyCote 115 or Duraplate 6000	100 100	25.0-100.0/ 40.0-125.0
	International Paint: Enviroline 222	100	20.0-100.0 (typically 70.0-80.0)
	PPG: Amerthane 490	100	20.0-100.0
L	**Tnemec:** Series 141	82	6.0-14.0
	Carboline: Reactamine 28 or Carboguard 1340 WB	100 55	1.0-2.0 1.5-2.0
	International Paint: Interzone 954	85	14.0-18.0 (typically 18.0-20.0)
	PPG: Amerlock 2	85	4.0-8.0
M	**Tnemec:** Series 431 Perma- Shield PL	100	30.0-40.0
	Carboline: Reactamine ET	100	30.0-40.0
	Sherwin Williams: Duraplate UHS or Duraplate 6000	100 100	30.0-40.0 40-60
	PPG: Novaguard 890	100	25.0-30.0

CLASSIFICATION OF PAINTS			
Paint Group	**Product Name and Number**	**Volume Solids %**	**Dry Film Thickness Mils per Coat**
N	**Tnemec:** Series FC22 or 22 Epoxoline	100	20.0-30.0
	Carboline: Phenoline Tank Shield / Polyclad 777 Series	100	20.0-30.0
	Sherwin Williams: Sher Plate PW or Duraplate UHS	100 100	25.0-35.0 25-35
	International Paint: Interline 975P	100	30.0-40.0 (up to 50.0 mils max)
	PPG: Novaguard 810 ER	100	20.0-40.0

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Surface Preparation: Prior to painting, Surface preparation prior to painting shall be in accordance with the following guidelines and as recommended by the painting material manufacturer.

SURFACE PREPARATION GUIDELINES	
Class of Work	Preparation of Surface Prior to Painting
Structural Steel and Steel Encased in Concrete, Masonry or Fireproofing	All visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter shall be removed by compressed air nozzle blasting, centrifugal wheels or other specified method. Discoloration caused by certain stains shall be limited to no more than 33 percent of each square inch of surface area in accordance with Society of Protective Coatings (SSPC-SP6).

SURFACE PREPARATION GUIDELINES	
Class of Work	Preparation of Surface Prior to Painting
Steel (other than structural, encased or galvanized) and Steel Submerged Under Water	All visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter shall be removed by compressed air nozzle blasting, centrifugal wheels, or other specified method. Discoloration caused by certain stains shall be limited to no more than five percent of each square inch of surface area in accordance with Society of Protective Coatings (SSPC-SP10).
Galvanized Steel and Other Metals	All welds, beads, blisters, or protuberances, other than identification markings shall be smooth, and other imperfections shall be removed. All nonferrous metals and galvanized steel, whether shop primed or field primed, shall be solvent cleaned in accordance with Society of Protective Coatings (SSPC-SP1).
Canvas Pipe Covering	All adhering debris shall be removed and indentations or other unsightly spots shall be smoothed out to give a uniform, even surface. Surfaces shall be brushed clean.
Gypsum Wallboard and Plastered Surfaces	Gypsum wallboard shall be prepared as recommended by the wallboard manufacturer. Plaster surfaces shall be dry. Scratches, cracks, holes and other defects shall be filled flush with adjoining surfaces by approved methods, sandpapered smooth, and brushed clean.
Concrete and Masonry Surfaces	Concrete and masonry shall be dried for a minimum of 28 days and then the dry concrete and masonry shall be brushed and washed to remove all loose dirt, dust, free lime, and other deleterious substances by approved methods. Protruding fins and other adhering matter shall be removed or ground until a smooth, even finish is obtained. Concrete surfaces to be painted shall be acid etched or otherwise roughened as recommended by the manufacturer of the coating to be applied, to produce a slightly granular surface required for adherence of coating to the concrete, unless otherwise indicated.
PVC	All adhering debris shall be removed and surface shall be roughened using suitable sandpaper. Surfaces shall be dry and free from dirt, oil, grease etc.

3.02 APPLICATION

A. General: All painting and coatings shall be applied in accordance with the manufacturer's recommendations and approved submittals. A representative of the paint manufacturer shall inspect the surfaces to be painted and shall advise on the proper application. The paint manufacturer representative shall periodically be consulted regarding ambient temperature and humidity conditions.

B. Shop Painting: The following items shall be provided with shop coats of primer and finish coats as herein specified before exposure to the weather:

1. Metals:

   a. Structural steel

      Note: Consider using hot dip galvanizing at crevices or hard to reach places on structural steel.

   b. Miscellaneous steel and wrought iron

   c. Ornamental wrought and light iron

   d. Iron castings

2. Machinery and Equipment:

   a. Mechanical and electrical equipment

3. Pipe:

   a. All piping except galvanized iron, stainless steel, aluminum, copper, brass, and bronze piping.

C. Field Painting: All painting at the Site of the Project is hereby designated as field painting for those items that cannot be shop painted or are touched up due to minor damage to the painted surface.

1. Repair and Repainting: Field coatings shall not be applied until all marred surfaces have been repaired or repainted. Shop coated surfaces shall be thoroughly cleaned and retouched prior to the application of successive paint coats in the field.

2. Unpainted Materials: Do not paint or finish copper, bronze, chromium plate, nickel, stainless steel, aluminum (except ducts and conduit adjacent to finish painted surfaces), monel metal, lead, lead coated copper, and brass, except as otherwise indicated.

3. Items to Receive Coating: All ferrous metals and insulated surfaces shall be provided with a protective coating. Interior surfaces, exposed masonry walls and concrete walls, floors and ceilings shall be provided with protective coatings as specified.

4. Surface Condition: Only surfaces that are dry and free from dust, grease or other undesirable or interfering substances shall receive coatings. Coatings shall be as specified in the “Material Painting Schedule” , attached after the “End of Section” designation.

5. Application: Finish coats shall be applied after all adjacent work has been completed. Successive coats shall have different shades or tints of color wherever possible. Colors shall be as selected and approved by the Engineer. Prime and successive finish coats shall be cleaned, sand papered, or otherwise treated before the next coat is applied, in accordance with the

recommendations of the coating manufacturer, and as approved by the Engineer. All coats shall be inspected and approved by the Engineer, before application of any succeeding coats. All coats shall be applied to the dry film thickness (DFT) specified. Coatings shall be applied by skilled personnel under adequate illumination. All painted surfaces shall be left in a clean, orderly, and acceptable condition.

6. Surface and Atmospheric Conditions: Paints shall not be applied when the surface temperature is less than 40 degrees Fahrenheit, when the relative humidity exceeds 85 percent, or when the surface to be painted is wet or damp, unless more stringent requirements are called for by the paint manufacturer.

D. Field Painting Operations: Surfaces to be given protective coating shall be thoroughly cleaned. Scratches and abrasions on equipment which has been shop coated shall be refinished, and all surfaces to be field painted shall be approved by the Engineer before proceeding with painting. Painting shall be performed in a continuous and orderly operation to facilitate adequate inspection, however material subject to weathering or corrosion shall be given prime coats as quickly as practicable.

1. Method of Application: All paint material shall be applied by brush or roller. Spray painting will be permitted only with the specific approval of the Engineer. Surfaces which are so close together as to prevent the insertion of a standard size roller or brush shall be painted thoroughly with the prescribed number of coats by using special narrow rollers or brushes.

2. Adjacent Areas: Areas under and adjacent to painted surfaces shall be fully protected at all times. Dripped or spattered paint shall be promptly removed, and any adjacent surfaces that have been damaged or discolored by overspray shall be repaired, refinished, and repainted.

3. Tinting: Successive coats of paint shall be tinted to make the various coats easily distinguishable. Undercoats of paint shall be tinted to the approximate shade of the final coat of paint. Final coats of paint shall not be applied until all other Work has been completed, the dirt and rubbish removed, and the surfaces suitably prepared. Paint to be applied shall be at room temperature.

4. Conditions for Application: Each coat of paint shall be given sufficient time to cure per the manufacturer's recommendation before application of the succeeding coat. Each succeeding coat shall be applied within the recoat time specified by the manufacturer; otherwise the painted surface shall be prepared per the manufacturer's recommendation before it is recoated. Exterior painting will not be allowed in dust laden air, during damp or threatening weather, or on moist or wet surfaces, or when the surface temperature is below 40 degrees Fahrenheit on a falling thermometer or under 50 degrees for catalyzed epoxy material; it will not be allowed in extreme heat or when metal is hot enough to cause the paint to blister and

produce a porous film. Do not apply interior painting until the building is thoroughly dry. If the temperature in the interior of the building, in the opinion of the Engineer, is too low, painting will be stopped until the building is heated. Proper ventilation and sufficient heat shall be maintained to permit the paint to dry. The building shall be maintained to be free from dust.

5. Remedial Work: Any paint found defective shall be removed. Touch-up and remedial painting shall be provided as directed and as required until Completion and Acceptance of final Work. If damage to the painted surface is excessive, as determined by the Engineer, that item shall be rejected and shipped back, at Contractor's expense, to be properly recoated before it can be accepted.

6. Application: Each coat of paint shall be applied as a continuous film of uniform thickness, free of pinholes and blemishes, to the maximum extent practicable. Any thin spots or areas missed in the application shall be repainted and permitted to dry before the next coat is applied. An approved low voltage wet sponge "holiday" detector shall be used as directed by the Engineer. All paint shall be carefully applied to a smooth even coating without runs or sagging. Enamels shall be brushed with a smooth even flow. Each coat of paint shall be dry, not only on the surface, but throughout the thickness of the paint film, before the next coat is applied. Finished surfaces shall be uniform in gloss, finish, and color, and free from flash spots and brush marks. In all cases, the resultant paint film produced shall be satisfactory in all respects to the Engineer.

7. Thinning: If the paint material must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material (i.e., one gallon of paint as originally furnished must not cover a greater surface area when sprayed than when applied un-thinned by brush). Where thinning is necessary, only the products of the manufacturer furnishing the paint shall be used for the particular purpose, and thinning shall be done with the manufacturer’s knowledge, in accordance with his printed instructions.

8. Thickness and Adhesion Testing: Dry film thickness of each coat shall be as specified herein. Dry film thickness will be checked by the Engineer or a representative with a magnetic gauge for ferrous metal in accordance with SSPC 2 or Tooke gauge destructive test for concrete. Film thickness of shop coats or other previously applied coating shall be checked by the Engineer or a representative and recorded before painting in order to determine thickness of field coats. Dry film thicknesses for concrete surfaces shall be determined by measuring with a wet-film gauge and by material consumption. Paint adhesion shall be tested by the peel method in accordance with ASTM D 3359.

9. Inaccessible Items: Exposed members which will be inaccessible after erection shall be painted and cleaned prior to erection.

10. Coverage: All surfaces to be painted shall be completely covered. When color on undercoats shows through the final coat of paint, surfaces shall be covered by additional coats until paint is of uniform color and appearance and coverage is complete.

11. Safe Atmosphere: The Contractor shall provide sufficient temporary ventilation during painting operations in enclosed areas to remove moisture and solvents, and to keep the atmosphere safe from harmful or dangerous fumes and dust levels for personnel.

E. Workmanship: Only skilled painters shall perform the Work and specialists shall be employed where required. Finished surface shall not show brush marks or other irregularities. Top and bottom edges of doors shall be painted as required for the adjacent surfaces. Undercoats on hollow metal shall be thoroughly and uniformly sanded with No. 00 sandpaper, or equal abrasive, to remove all surface defects and provide a smooth, even surface.

F. Mixing: All paints and coatings shall be mixed in accordance with the manufacturer's instructions on the printed label. The Contractor shall provide galvanized iron pans of sufficient size to contain all mixing pails and mix all paints and ingredients therein.

G. Rates of Application: Paints shall be applied so as to give coverage per gallon not greater than that recommended by the manufacturer. Quantities of paint used for successive coats on the various parts of the Work shall be recorded in a manner satisfactory to the Engineer.

H. Touch-Up of Shop-Primed and Finished Items: Touch-up of any and all damaged portions and imperfections in shop-primed and finished items shall be accomplished using the same paint as used for the shop prime and finish. Surface shall be prepared prior to touch-up by wire brushing and sanding to remove rust, scale, and loose paint.

I. Aluminum and Incompatible Surfaces: Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete, or other masonry materials, one field coat of Group A paint as specified under Article 2.03 "Classification of Paints" in this Section shall be applied to the incompatible surfaces.

J. Concealed Surfaces: All wall surfaces which will be concealed by equipment shall be painted before equipment installation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. The Contractor shall touch up and restore any finish damaged. Paint or other finishes spilled, splashed, or splattered shall be removed from all surfaces using care so as not to mar any surface or item being cleaned.

1. The Contractor shall rectify any failures or breakdowns, loosening of the paint, or coatings within a year after acceptance of work, regardless of the paint systems used. This will require removal of the entire coating where failure occurs and repainting with the coating system previously specified. Patching will not be allowed.

END OF SECTION

NO TEXT ON THIS PAGE

MATERIAL PAINTING SCHEDULE																				
Materials and Conditions	**Paint Groups (refer to "Classification of Paints" table for acceptable paints in Groups A-N)** **Tn: Tnemec, Cb: Carboline, SW: Sherwin Williams, IP: International paint, PPG: PPG/Amercoat**																			
	Prime Coat					**Finish Coats**														
						1st					**2nd**					**3rd**				
Paint Manufacturer	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**
Steel and Iron - Structural and Miscellaneous Uses:																				
Interior (Indoors) shop primed, field finished	B or E or I	A	A or D	A	A	B or I	A	D	A	B	B or I	A	D	A	B	--	A	D	A	B
Exterior (Outdoors) shop primed, field finished	B or I	A	A or D	A or B or E	A	C	A	D	A or B	B	--	A	D	A	B	--	C	C	C	C
Submerged, Buried or Continuously Wet Exposed to sewage, shop primed, field finished	B or I	A	A	B	B	J or K or L or M	A	B or J	B	B	--	D	B or J	D	B	--	D	B or J	D	--
Steel and Iron - Industrial Equipment (Exposed to wastewater):																				
Submerged, Buried or **continuously wet in wastewater**, completely shop coated inside and out, includes OEM factory finished items such as gates, valves, etc.	J or K or L or M	A Or K*	A or M*	D or K or L	A	J or K or L or M	A	B or J	D	B	--	A	B or J	D	B	--	--	B or J	D	B

MATERIAL PAINTING SCHEDULE																				
Materials and Conditions	**Paint Groups (refer to "Classification of Paints" table for acceptable paints in Groups A-N) Tn: Tnemec, Cb: Carboline, SW: Sherwin Williams, IP: International paint, PPG: PPG/Amercoat**																			
	Prime Coat					**Finish Coats**														
						1st					**2nd**					**3rd**				
Paint Manufacturer	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**
Above grade, indoors, **exposed to waste water**, completely shop coated inside and out, includes OEM factory finished, items such as gates, valves etc.	J or K or L or M	A or N*	A or M*	D or K or L	A	J or K or L or M	A	B or J	A or D	B	--	A	B or J	A or D	B	--	--	B or J	A or D	--
Above grade, outdoors, **exposed to waste water**, completely shop coated inside and out, includes OEM factory finished, items such as gates, valves etc.	J or L or M	A or N*	A or M*	D or E or K or L	A	J or L or M	A	B or L	A or D	B	--	A or C	B or J	A or D	B	--	--	C	A or D	--
Inside of item immersed in sewage	J or K or L or M	A or N*	A or M*	D or K or L	B	J or K or L or M	A	B or J	D	B	--	A	B or J	D	B	--	--	B or J	D	B
Ductile Iron or Steel Process Piping, submerged, Buried or constantly wet, **exposed to sewage**, H2S exposures, OEM factory finished.	M*	A or K*	A Or M*	D or K	M	--	A	B	D or K	--	--	A	B or J	D or K	--	--	--	B or J	D or K	--
Steel and Iron - Industrial Equipment (Exposed to Potable water):																				

MATERIAL PAINTING SCHEDULE																				
Materials and Conditions	**Paint Groups (refer to "Classification of Paints" table for acceptable paints in Groups A-N) Tn: Tnemec, Cb: Carboline, SW: Sherwin Williams, IP: International paint, PPG: PPG/Amercoat**																			
	Prime Coat					**Finish Coats**														
						1st					**2nd**					**3rd**				
Paint Manufacturer	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**
Shop primed, field finished	B or I	A or J	E or I	B or I	A	B or I	D	I	B or I	B	B or I	D	I	B or I	B	--	--	--	B or I	--
Exposed to Potable water (NSF) completely shop coated, inside and out, OEM factory finished items such as Gates, Valves etc.	B or I	A or J	E or I	B or I or N	A	B or I	D	I	B or I	B	B or I	D	I	B or I	B	--	--	--	--	--
Equipment above grade, indoors, **exposed to Potable water** (NSF), completely shop coated inside and out, OEM factory finished items such as Gates, Valves etc.	B or I	A or J	E or I	B or I or N	A	B or I	D	I	B or I	B	B or I	D	I	B or I	B	--	--	--	--	--
Equipment above grade, outdoors, **exposed to Potable water** (NSF), completely shop coated inside and out, OEM factory finished items such as Gates, Valves etc.	N*	A or J	E or I or N*	B or I or N	N*	--	D	I	B or I	--	--	D	I	B or I	--	--	--	--	--	--
Ductile Iron or steel process piping **exposed to Potable Water** (shop finished) alternate	N*	A or L or N*	E or I or N*	B or I or N	N*	--	A	I	B or I	--	--	C	I	B or I	--	--	--	--	--	--
MISCELLANEOUS USES:																				
Piping concealed in Masonry	B or I	A	A	A	A	A	A	D	A	B	A	--	D	A	B	--	--	--	--	--

MATERIAL PAINTING SCHEDULE																				
Materials and Conditions	**Paint Groups (refer to "Classification of Paints" table for acceptable paints in Groups A-N) Tn: Tnemec, Cb: Carboline, SW: Sherwin Williams, IP: International paint, PPG: PPG/Amercoat**																			
	Prime Coat					**Finish Coats**														
						1st					**2nd**					**3rd**				
Paint Manufacturer	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**
Piping wrapped in Insulation	A	A	A or D	A or B	A	A	A	D	A or B	B	A	--	D	A or B	B	--	--	--	--	--
Heated Metal (Air Main Piping): Submerged, Buried and Exposed	J or L or M*	D or E or M*	D or M*	D	D	--	E	D	D	D	--	A or D	D	D	--	--	A or D	D	D	--
Concrete Masonry: Interior	F	--	F	--	F	A or D	F	D	F	B	D	A	D	D	B	D	A	D	D	--
Concrete: Interior excluding floors	A	B	--	--	A	A or D	A	D	D	B	D	A	D	D	B	--	--	--	D	--
Concrete: Immersion, Waste Water	A or J or L	J or L	--	--	N	A or J or L	D or I or K*	I	D	N	--	D	B or J or K	D	--	--	--	--	D or K	--
Pipe and Duct Insulation: Exposed	A	--	--	--	A	H	B	H	H	B	H	H	H	H	B	--	--	--	--	--
PVC (Interior)	A	--	--	--	A	A	B	D	A	B	A	A	D	A	--	--	--	--	--	--
PVC (Exterior)	A	--	--	--	A	A	B	D	A	C	A	C	C	A	--	C	--	C	C	--
Gypsum Wallboard and Plaster:	G	B	G	G	G	H	H	H	H	H	H	H	H	H	--	H				--

MATERIAL PAINTING SCHEDULE																				
Materials and Conditions	**Paint Groups (refer to "Classification of Paints" table for acceptable paints in Groups A-N)** **Tn: Tnemec, Cb: Carboline, SW: Sherwin Williams, IP: International paint, PPG: PPG/Amercoat**																			
	Prime Coat					**Finish Coats**														
						1st					**2nd**					**3rd**				
Paint Manufacturer	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**	**Tn**	**Cb**	**SW**	**IP**	**PPG**
Nonferrous Metal and Galvanized steel: Interior	A	--	--	--	A	A	G	D	A	B	A	A	D	A	--	A	--	D	A	--
Nonferrous Metal and Galvanized Steel: Exterior	A	--	--	--	A	A	G	D	A	C	A	C	C	A	--	C	--	C	C	--
* Requires only one coat.																				

NO TEXT ON THIS PAGE

SECTION 10 14 01 – IDENTIFYING DEVICES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Identifying devices as specified herein shall include standing signs and door- and wall-mounted signs and appurtenances.

B. Identifying devices shall be provided as specified in the Contract, in accordance with the NYC Fire Code and NYC Building Code, and as required for a complete installation of the equipment or structure.

C. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.01 - Welding

B. Section 05 05 23.02 - Miscellaneous Metal Fastenings

C. Section 05 12 00 - Structural Steel Framing

1.04 REFERENCES

A. OSHA - 1910.145 – Specifications for Accident Prevention Signs and Tags

B. NYCBC - New York City Building Code

C. ANSI/ICC A117.1 - Accessible and Usable Buildings and Facilities

D. AWS A5.12 - Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting

E. AWS D1.1 - Structural Welding Code - Steel

1.05 DESCRIPTION

A. Sustainable Design Requirements

1. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesives: Do not use adhesives that contain added urea formaldehyde.

3. Composite Wood and Agrifiber Products: Do not use composite wood and agrifiber products that contain added urea formaldehyde.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Engage a single fabricator, with undivided responsibility for detailing and performance of the signage structure and door- and wall mounted signs.

2. Engage a firm which can show five years previous successful experience in detailing and fabrication of signage paneling, signage structures, and door- and wall-mounted signs, of scope and type similar to the required Work.

3. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests shall not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Installer Qualifications:

1. Engage a single installer skilled, trained, and with documented successful experience in the installation of signage structures and wall mounted metal lettering, and with specific skill and successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to the Engineer along with the following information on a minimum of three successful projects:
    a. Names and telephone numbers of owner, architects or engineers responsible for projects.
    b. Approximate contract cost of the ornamental fences and gates.
    c. Amount of area installed.

C. Source Quality Control:

1. Obtain all signage structure components and accessories from the same manufacturer.
2. Provide qualified welding processes and welding operators in accordance with AWS D1.1, Section 6 “Qualification”.
3. Provide certification that all welders employed on, or to be employed for, the fabrication of the signage structures and wall mounted metal lettering, have satisfactorily passed AWS qualification tests within the previous twelve months. Contractor shall ensure that all certifications are kept current.

1.07 SUBMITTALS

A. The Contractor shall submit for approval, catalog cuts, Shop Drawings, and reference materials.

B. Shop Drawings

1. The Contractor shall submit copies of specifications, installation instructions, and general recommendations from the identifying device manufacturers, for each type of identifying device product. Manufacturer's data substantiating that the materials comply with the requirements of the Contract Documents shall be included.
2. Drawings showing extent of the Work and all details required for the Work referencing system components provided as samples, and shall include:
    a. Complete details for all signs giving sizes and styles of lettering and colors.
    b. Complete schedules for all signs, giving the location, message, letter, size, color, and method of attachment.
    c. Details of fabrication and attachment of all items.
    d. Complete location plan for all sign types.

C. Samples

1. Submit for approval color and finish samples of each identifying device product, including each accessory and miscellaneous material to be used in the Work.

D. Mockups

1. Mockups of each type of Identifying Device , shall be done in shop and await approval before installation.

E. Sustainable Design Submittals

1. Environmental Materials Reporting Form (EMRF) Recycled Content Materials. Provide the following information:

   a. Name of Product and Manufacturer.

   b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

   c. The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

2. Environmental Materials Reporting Form (EMRF) - Composite Wood Products. Include the following information:

   a. Confirmation that composite wood and Agrifiber products contain no added urea formaldehyde.

   b. For each laminate adhesive used on Site and in the shop, documentation indicating that the adhesive contains no added urea formaldehyde.

3. VOC Reporting Form. Provide the following information:

   a. For all adhesives used on site, provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Materials shall not be delivered to the Project Site before the time of installation.

2. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

3. All welding and fastening shall be done in shop prior to delivery to the Site to minimize installation time.

B. Storage of Materials:

1. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

2. All materials shall be stored in a dry, enclosed area, off the ground and away from all possible contact with water, ice, or snow.

3. Damage to materials during storage shall be prevented by minimizing the amount of time they are stored at the Site before being incorporated into the Work.

C. Handling of Materials:

1. Materials shall be handled in such a manner to avoid damage or breakage.

2. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work.

3. Packages or containers shall not be opened until all necessary preparatory Work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall provide a manufacturer's warranty for a minimum of five (5) years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for approval by the Engineer.

1. ASI Signage, Dallas TX.

2. Gemini, Inc., Cannon Falls, MN.

3. Vista System, Sarasota, FL

4. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. General:

1. Accessibility Standard: Comply with applicable provisions in ICC A117.1 for signs.

2. Signs shall be in accordance with the NYC Fire Code, the NYCBC and as directed by the Engineer.

B. Standard Signs and Handicap Signs:

1. All standard signs information shall be as per the Contract Drawings.

2. All mounting hardware shall be as provided as shown on the Contract Drawings.

3. All signage imagery shall be provided as shown in Attachment 1, and shall be digitally printed on non-directional stainless steel panels.

C. Attachments: All attachments and anchors necessary for concealed installments of identifying devices shall be furnished.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Door- and Wall-Mounted Signs

1. All surfaces shall be cleaned and prepared to receive the signs as per the Contract Documents.

2. All pegs/bolts/nuts/clips, etc., fastening the signs to the wall surface shall be of like materials or separated by neoprene washers.

3. The Contractor shall follow requirements for metal fastening as per Section 05 05 23.02 - Miscellaneous Metal Fastening.

B. Gate Mounted Signs

1. All welding to be done in shop unless otherwise indicated on the Contract Documents.

2. All bolts/nuts/clips, etc., fastening the signs to the gates shall be of like materials or separated by neoprene washers.

3. All welding is to be done in accordance with Section 05 05 23.01 – Welding.

4. All structural steel fabrication shall be done in accordance with Section 05 12 00 - Structural Steel Framing.

C. Welding

1. For all welding in shop or in field the Contractor shall adhere to AWS A5.12, AWS D1.1 and any other applicable reference.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive identifying devices are properly prepared and completed.

3.02 INSTALLATION

1. All materials specified herein shall be installed in compliance with the NYCBC, ANSI A117, OSHA regulations, and the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts, and the like

shall be in accordance with the Contract Drawings, and all related sections listed herein.

B. Identifying devices shall be installed where shown on the Contract Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjustment: System components which are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Specifications and properly protected as specified.

B. Protection: Identifying devices shall be protected from all damage and abuse from all other Contractors and installers involved in the Work until Final Acceptance by DEP.

C. Cleaning: Upon completion of the Project, all protection devices shall be removed and identifying devices shall be touched up as necessary. All exposed surfaces shall be cleaned using a mild solution of detergent and warm water. All surfaces shall be left in a neat and clean condition.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 10 28 10 – TOILET AND BATH ACCESSORIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Toilet and bath accessory work includes, but is not limited to, furnishing and installing wall mirrors, paper towel dispensers, waste receptacles, toilet tissue dispensers, grab bars, soap dispensers, and feminine napkin vendor and disposal units. Extent of each type of toilet accessory is shown on the Contract Drawings and schedules.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	2
PART 2	PRODUCTS	2
2.01	Manufacturers	2
2.02	Materials / Equipment	2
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	3
PART 3	EXECUTION	3
3.01	Examination / Preparation	3
3.02	Installation	3
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	4

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Not Used

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Inserts and anchoring devices shall be set in concrete or built into masonry.

B. Accessory locations shall be coordinated with other work to avoid interference and to assure proper operation of the accessory units.

1.07 SUBMITTALS

A. Contractor shall submit technical data and installation instructions for each type of toilet accessory for approval by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Products shall be as manufactured by:
    a. American Specialties, Inc., Yonkers, NY.
    b. Bobrick Washroom Equipment, Inc., North Hollywood, CA.
    c. Bradley Corp., Menomonee Falls, WI.
    d. Watrous, Inc., Pickering, ON, Canada.
    e. Or approved equal

2.02 MATERIALS / EQUIPMENT

TOILET ACCESSORIES

A. The Contractor shall provide the following toilet accessories. Model number refers to products supplied by The Bradley Corp., but equivalent products from other approved equal manufacturers may be provided.

1. Multi-purpose Unit:
    a. Model No. 155. Recessed Mirror, Towel Dispenser Multi-Purpose Unit. Unit shall be stainless steel type 304 (18-8) satin finish.

b. Model No. 1471. Recessed Soap, Towel Dispenser Shallow Multi-Purpose Unit. Unit shall be stainless steel type 304 (18-8) satin finish.

2. Waste Receptacle: Model No. 2017-10. Semi-recessed unit, with hinged cover and push flap door. Unit shall be stainless steel type 304 (18-8) 22 Ga. satin finish. Unit shall come complete with heavy duty vinyl liner.

3. Napkin/Tampon Dispenser and Disposal: Model No. 403 recessed unit with stainless steel waste receptacle and push flap door. Unit shall be stainless steel type 304 (18-8) satin finish.

4. Toilet Tissue Dispenser: Model No. 5402. Surface mounted dual roll unit with theft resistant device. Unit shall be stainless steel type 304, satin finish.

5. Grab Bars: Model No. 817-2. Provide 12-inch O.D. exposed mounting, heavy duty stainless steel with sanitary safety grip. Units shall be 3'-6" long or as indicated otherwise on the Contract Drawings.

6. Utility Shelf: Model No. 758. Shall be 8-inches wide x 24-inches long stainless steel type 304 (18-8) 18 Ga. with satin finish.

7. Seat Cover Dispenser: Model No. 583. Shall be surface mounted stainless steel type 304 22 Ga. with satin finish.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Installer shall examine substrates, previously installed inserts, and anchorages necessary for mounting of toilet accessories and other conditions under which installation is to occur, and shall notify the Contractor of conditions detrimental to proper completion of Work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. Toilet accessory units shall be installed in accordance with manufacturer's instructions, and use fasteners which are appropriate to substrate and recommended by the manufacturer of the unit. Units shall be installed plumb and level, firmly anchored in locations indicated.

B. Install mirrors with back frame concealed fasteners.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Toilet accessories shall be adjusted for proper operation so that mechanisms function smoothly.

B. All exposed surfaces shall be cleaned and polished after removing protective coating.

END OF SECTION

SECTION 10 75 00 – FLAGPOLES

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Provide roof-mounted flagpole made from aluminum in compliance with Contract Documents.

B. Owner-Furnished Material: Flag[s].

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 43 10 - Quality Assurance Inspection

C. Section 01 35 63 – Sustainability Certification Project Requirements

D. Section 01 65 00 – Product Delivery Requirements

E. Section 03 30 00 – Cast–in–Place Concrete

1.04 REFERENCES

A. Aluminum Association (AA):

1. M12C22A31: Mechanical Finish
2. M12C22A32/A34: Mechanical Finish
3. M12C22A41: Anodized Plus Finish
4. M12C22A42/A44: Mechanical Finish
5. M20: Natural Satin Finish
6. M21-06x: Mechanical Finish
7. M31-C55: Mechanical Finish.
8. M32: Natural Satin Finish
9. M32-06x: Mechanical Finish.
10. M32C22A43: Gold Anodic Finish

B. American Architectural Manufacturers Association (AAMA):

1. 611: Voluntary Specification for Anodized Architectural Aluminum
2. 2603: Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
3. 2604: Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
4. 2605: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

C. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures - Includes Supplement No. 1

D. ASTM International (ASTM):

1. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. A312: Seamless and Welded Austenic Stainless Steel Pipe.
4. A269: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

5. A513: Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
6. A666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
7. B43: Standard Specification for Seamless Red Brass Pipe, Standard Sizes
8. B135/B135M: Standard Specification for Seamless Brass Tube
9. B241: Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
10. C33: Standard Specifications for Concrete Aggregates
11. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
12. D1187: Type II – Specification for Asphalt-Base Emulsions (For Metal Surfaces).

E. National Association of Architectural Metal Manufacturers (NAAMM):

1. FP 1001: Guide Specifications for Design of Metal Flagpoles.
2. Metal Finishes Manual for Architectural and Metal Products.

F. The Society for Protective Coatings (SSPC):

1. SP5: White Metal Blast Cleaning
2. SP8: Pickling

1.05 DESCRIPTION

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:

1. Seismic Loads:
   a. Seismic Loads: Site-specific seismic design parameters per ASCE 7, including Seismic Design Category and spectral response accelerations S_{DS} and S_{D1} as determined for the project site.
2. Wind Loads: 132 miles per hour
4. Base flagpole design on flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.06 QUALITY ASSURANCE

A. Comply with the requirements specified in Section 01 43 10 - Quality Assurance Inspection.

B. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.07 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

C. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other Work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

1. Include section and details of foundation system for ground-mounted flagpoles.

2. Include details of roof-mounted connections and mountings.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

F. Qualification Data: For qualified Professional Engineer.

G. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

H. Sustainable Design:

1. Comply with the requirements specified in Section 01 35 63 – Sustainability Certification Project Requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements specified in Section 01 65 00 – Product Delivery Requirements.

B. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

C. Protect flagpole and accessories from damage or moisture.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:

1. American Flagpole; a Kearney-National Inc. company.
2. Atlantic Fiberglass Products, Inc.
3. Baartol Company.
4. Concord Industries, Inc.
5. Eder Flag Manufacturing Company, Inc.
6. Ewing Flagpoles.
7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.

2.02 MATERIALS / EQUIPMENT

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.

2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

3. Provide self-aligning, snug-fitting joints.

B. Aluminum Flagpoles: Provide **cone**-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/, Alloy 6063, with a minimum wall thickness of 3/16-inch (4.8 mm).

C. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.

1. Provide units made from with same finish and color as flagpole.

2. Provide connector to building's lightning protection system conductor at roof-mounted flagpoles.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fittings

1. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

a. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.

2. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

3. Halyard Flag Snaps: Provide two **stainless-steel** swivel snap hooks per halyard.

a. Provide with neoprene or vinyl covers.

4. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.

a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

C. General Finish Requirements:

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Aluminum Finishes:

1. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Place concrete, as specified in Section 03 30 00 – Cast–in–Place Concrete. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

D. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.02 INSTALLATION

A. General: Install flagpoles where shown, and according to Shop Drawings and manufacturer's written instructions.

B. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

C. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 11 13 13 – LOADING DOCK BUMPERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install the dock bumpers and all appurtenances and accessories as shown and specified.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	2
PART 2	PRODUCTS	2
2.01	Manufacturers	2
2.02	Materials / Equipment	2
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	3
PART 3	EXECUTION	3
3.01	Examination / Preparation	3
3.02	Installation	3
3.03	Field Testing / Quality Control	3
3.04	Startup / Demonstration	3
3.05	Adjusting / Protection / Cleanup	3

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 13.01 - Galvanizing

1.04 REFERENCES

A. Not Used

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. The equipment specified by this Section is intended to be standard equipment of proven performance as manufactured by reputable manufacturers.

B. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade and shall perform satisfactorily when installed in accordance with the Contract Documents.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittal shall include, but not be limited to:

1. Equipment specifications and data sheets identifying all materials used and methods of fabrications.

2. Complete assembly, layout, and installation drawings with legibly marked dimensions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Dock Bumpers

1. Dock bumpers shall be of ozone-resistant, laminated construction with a six-inch projection. Bumpers shall consist of 5/8-inch thick rubberized fabric pads strung on 3/4-inch steel rods and closed with 1/4-inch angle brackets on both ends.

2. Steel rods, angle brackets and other miscellaneous steel shall be hot-dip galvanized in accordance with Section 05 05 13.01 - Galvanizing.

3. All anchor bolts shall be Type 316L stainless steel.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination of the Site

1. Prior to starting Work, the Contractor shall verify that the dimensions and profiles of dock bumpers specified are acceptable for installation by taking measurements at the Site. Include dimensions verified at the Site in Shop Drawing submission.

B. Preparation

1. The Contractor shall not proceed with the Work until all conditions detrimental to the Work have been corrected in a manner acceptable to the Engineer.

3.02 INSTALLATION

A. The dock bumpers shall be installed by the Contractor in accordance with the manufacturer's instructions, approved Shop Drawings and the Contract Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 21 10 00 – WATER BASED FIRE-SUPPRESSION SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all plumbing fixtures completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	13
2.04	Source Quality Control / Shop Tests	14
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Installation	15
3.03	Field Testing / Quality Control	19
3.04	Startup / Demonstration	21
3.05	Adjusting / Protection / Cleanup	21

C. Plumbing fixtures shall be as indicated in the Plumbing Fixture Schedule as shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 09 91 00 - Painting

C. Section 28 31 00 – Fire Detection and Alarm

D. Section 33 01 10.60 – Disinfection of Piping

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	ARI	American Refrigerating and Air
2.	CABO	Council of American Building Officials
3.	GPF	Gallons per Flush
4.	USCS	U.S. Department of Commerce Commercial Standard

B. Reference Standards:

1.	ASTM A36	Carbon Structural Steel.
2.	ASTM A47	Malleable Iron Castings.
3.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
4.	ASTM A536	Ductile Iron Castings.
5.	ASTM A795	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
6.	ASME B1.20.1	Pipe Threads, General Purpose (Inch)
7.	ASME B16.1	Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.
8.	ASME B16.3	Malleable Iron Threaded Fittings.
9.	ASME B16.4	Cast Iron Threaded Fittings.
10.	ASME B16.9	Factory-Made Wrought Steel Butt- Welding Fittings.
11.	ASME B16.11	Forged Fittings, Socket-Welding and Threaded.
12.	ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges.
13.	ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series).
14.	ASME B18.2.2	Square and Hex Nuts (Inch Series).
15.	ASME B40.1	Gauges - Pressure Indicating Dial Type.
16.	ASSE 1015	Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.
17.	AWS D10.9	Qualification of Welding Procedures and Welders for Piping and Tubing.

18.	AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
19.	AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems.
20.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
21.	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
22.	AWWA C601	Disinfection
23.	FM P7825	Approval Guide.
24.	MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture.
25.	NFPA 13	Installation of Sprinkler Systems.
26.	NFPA 24	Installation of Private Fire Service Mains and Their Appurtenances.
27.	NFPA 25	Inspection, Testing, and Maintenance of Water Based Fire Protection Systems.
28.	NFPA 291	Fire Flow Testing and Marking of Hydrants.
29.	UL 04	Fire Protection Equipment Directory.
30.	UL 262	Gate Valves for Fire-Protection Service.
31.	UL FIRE PROT DIR	Fire Protection Equipment Directory.
32.	U.S. Department of Commerce Commercial Standard.	
33.	New York City Building Code.	

1.05 DESCRIPTION

A. This Section includes requirements for providing a water-based sprinkler system in accordance with applicable standards and regulations. In addition:

1. Design and provide new automatic wet pipe fire suppression sprinkler systems for the areas indicated, and confirm they are in compliance with Contract Documents so that they are complete and ready for operation.

2. The Work of this Section shall include all labor, materials, tools, equipment, and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section and the Contract Documents, and the codes and standards listed herein.

3. Provide a licensed Fire Protection Professional Engineer to design the systems.

1.06 QUALITY ASSURANCE

A. Installation shall be performed by a New York City Licensed Master Plumber (LMP) or a Licensed Fire Suppression Contractor (LFSC).

B. Comply with requirements of Owner's insurance underwriter for submittal, approvals, materials, installation, inspections, and testing.

C. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13.

D. Fire Protection Engineer: Hydraulic calculations, working drawings, record drawings, and installation inspection reports shall be prepared by, or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently licensed as a New York City Fire Protection Professional Engineer (PE) or Register Architect (RA).

E. Tests shall be conducted in presence of Authorities Having Jurisdiction. Fire Protection Subcontractor shall notify the Authorities Having Jurisdiction and Engineer a minimum of five days prior to performing tests.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Certificate of Design: Submit a completed certificate of design, prior to start of the design work. For Certificate form, see Section 01 33 00 – Submittal Procedures.

2. Action Submittals:

a. Shop Drawings:

1) Working Drawings - Prepare 24 by 36 -inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Drawings shall clearly show location of sprinkler heads with spacing dimensions as well as orientation of sprinkler heads in relation to obstructions; piping system layout including valve risers and trim, inspectors test connections, fire department connection, gauges, system drains, isolation valves, water flow alarms; and support and hangers. Building sections shall show typical branch line, main line and sprinkler head elevation above the floor. Show point to point electrical wiring diagrams. Submit Working Drawings stamped and signed by the Fire Protection Engineer.

2) Coordination Drawings – Prepare as specified in Paragraph "Cooperation and Coordination with Other Trades" of this Section.

b. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item:

1) Pipe, fittings and mechanical couplings.

2) Valves.

3) Sprinkler heads.

4) Alarm check valves.

5) Riser check valves.

6) Sight drains.

7) Backflow preventers. Submit a layout drawing indicating the location of all backflow preventers to the New York City Department of Environmental Protection (DEP) for their approval prior to submitting to the Engineer.

8) Pressure gauges

9) Audible alarms

10) Alarm initiating devices

11) Pipe hangers and supports.

c. Hydraulic Calculations:

1) Sprinkler system design - Prepare computer program generated hydraulic calculations in accordance with NFPA 13 to substantiate compliance with hydraulic design requirements. Submit name of software program used. Submit hydraulic calculations stamped and signed by the Fire Protection Engineer.

2) Provide hydrant flow test data less than one year old conforming to NFPA 291. In case of a winter test, provide comparison to local water department tests or estimates of minimum summer flow and pressure for basis of design. The lesser combined flow and pressure test results shall be used for the hydraulic design of the system.

d. Certification - Submit documentation certifying completion of the following items in compliance with this Section.

1) Flushing

2) Disinfection.

e. Test Reports - prepare as specified in Part 3 of this Section:

1) Test Procedures.

2) Pressure tests.

3) Alarm tests.

4) Flow tests.

5) Backflow preventer tests.

f. Provide a list of manufacturer's recommended special tools and spare parts to be supplied.

g. Operation and Maintenance Manuals:

1) Sprinkler heads.

2) Valves.

3) Alarm check valves.

4) Backflow preventers.

5) Audible Alarms

6) Alarm initiating devices.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the plumbing fixture for shipment shall be in accordance with the manufacturer's commercial practice subject to the approval of the Engineer.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Sprinkler heads shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. Sprinkler heads shall be protected from corrosion and deterioration, and plumbing fixtures shall be stored in a dry area.

a. Sprinkler heads stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Sprinkler apparatus interiors shall be kept free from dirt and foreign matter.

4. Sprinkler heads shall be properly protected from damage during construction, and shall be cleaned in accordance with manufacturer's instructions prior to installation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair and adjust the products provided under this Section, and as per the requirements of the Contract Documents. In addition:

1. Furnish the following spare parts:

a. Two (2) sprinkler heads.

B. Tools: Provide standard and special tools as well as supplies necessary to service, disassemble, repair, and adjust the products.

1.10 WARRANTY

A. None.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Material and equipment for fire protection service shall be UL 04 Fire Protection Equipment Directory listed and/or FM P7825 approved for use in wet pipe sprinkler systems where such classes of material and equipment are available as listed or approved by these organizations. Where the terms “listed” or “approved” appear in this Section, such shall mean listed or approved in the aforementioned directories.

B. Where applicable, all products requiring approval by the Massachusetts Department of Public Safety

C. All components subject to pressure shall be rated for minimum 175 psig working pressure.

D. Above Ground Piping:

1. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings shall not be permitted. Perform welding in the shop; field welding shall not be permitted. Conceal piping in areas with suspended ceilings.

2. Pipe, Fittings, and Mechanical Couplings:

a. NFPA 13, except as modified herein. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasketed fittings shall not be permitted.

b. Unless otherwise specified to be hot-dipped galvanized, pipe shall be black steel pipe and shall be pre-oxidized with a suitable protective coating. All empty piping that may be periodically filled with water including, but not limited to, drain piping, test piping, and fire department connection piping up to the check valve, shall be hot dipped galvanized inside and out.

c. Schedule 40 black steel pipe shall be ASTM A53, Type E, Grade B, or ASTM A795 Type E, Grade A for Schedule 30 or 40. Schedule 10 black steel pipe shall be ASTM A795, Type E, Grade A. Steel pipe shall be Schedule 40 for sizes 1 -inch and smaller, and Schedule 10 for sizes 1 1/4-inch and larger, except all steel pipe upstream of the alarm check valve including drain piping and test piping shall be Schedule 40.

d. Schedule 40 pipe 2-inch and smaller shall be joined by screwed joints in accordance with specification ASME B1.20.1.

e. Schedule 40 pipe 2 1/2-inch and larger shall be joined by flanged joints, welded joints, or by mechanical couplings. For mechanical couplings, pipe ends shall have cut grooves. Roll grooving shall not be permitted.

f. Schedule 10 pipe 1 1/4-inch and larger shall be joined by welded joints in accordance with AWS D10.9 or by mechanical couplings. For mechanical couplings, pipe ends shall have rolled grooves. Cut grooving shall not be permitted.

g. Screwed fittings shall be cast iron, class 125, black, and in accordance with ASME B16.4 or malleable iron, class 150, black, and in accordance with ASME B16.3.

h. Welded fittings shall be steel, standard weight, black, and in accordance with ASME B16.9 and ASME B16.11.

i. Flanged fittings shall be cast iron, short body, class 175 and in accordance with ASME B16.1, ASME B16.21, ASME B18.2.1, and ASME B18.2.2. Provide hexagon head machine bolts, hexagon head nuts, and washers, all heavy finished cadmium plated.

j. Rubber gasketed grooved mechanical couplings and fittings shall be NFPA 13 listed and approved and consist of combination housings and gaskets. Housings shall either be malleable iron ASTM A47 or ductile iron ASTM A536 and shall be hot-dipped galvanized where galvanized piping is specified to be used. Gasket material shall be listed for the intended service and shall be Grade "E", EPDM. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

    1) Mechanical couplings shall be Victaulic Style 07 "Zero Flex" couplings for rigid connections in equipment rooms;

Style 77 standard flexible couplings at pumps and vibration producing equipment; Style 77 at flexure points in equipment rooms and Style 75 at flexure points elsewhere (to meet seismic requirements); Style 72 outlet couplings; Style 750 reducers; and Style 741 "Vic-Flange" adapters at all valves and equipment connections 2 1/2-inch and larger.

2) Victaulic "installation-ready" couplings may be substituted, Style 107 for Style 07, and Style 177 for Styles 77 and 75.

E. Expansion: When crossing building expansion or seismic joints, expansion or seismic loops, as required by NFPA 13, shall be installed with the appropriate couplings to allow for expansion in agreement with that as provided for by the building joint. Piping shall be securely anchored to the building structure on both sides of the building expansion and/or seismic joint.

F. Sprinkler Heads:

1. Provide nominal 1/2-inch or 3/4-inch orifice sprinkler heads, 175 psig working pressure. O-rings will not be permitted in sprinkler heads. Release element of each head shall be of the ordinary temperature rating or higher as required by NFPA 13. Provide sprinkler head guards as specified and/or required by NFPA 13. Sprinklers shall be used in accordance with their listed and approved coverage limitations.

2. Unless otherwise specified or indicated, sprinkler heads shall be of conventional design, standard response or quick response, standard coverage, upright style. Extended coverage sprinklers shall not be used.

3. Sprinkler heads located in unfinished areas without ceilings (mechanical rooms, storage rooms, process areas, etc.) and combustible concealed spaces above ceilings shall be of conventional design, upright style, and shall have a rough brass finish.

4. Sprinkler heads located in finished areas without ceilings shall be of conventional design upright style and shall have a polished chrome finish.

5. Sprinkler heads located in areas with suspended ceilings shall be of conventional design, recessed pendent style, low profile ceiling plate (escutcheon) and shall have a polished chrome finish.

6. Sprinkler heads located at skylights shall be conventional design, polished chrome finish, style to suit, upright, pendant or sidewall.

7. Sprinkler heads to protect small unheated spaces shall be individual dry sidewall, pendent or upright style each connected separately to the wet-pipe sprinkler piping.

8. All recessed sprinkler heads shall be of the adjustable type.

9. Provide wax-coated heads in corrosive areas including, but not limited to, all heads in the Dewatering Building, and heads in chemical rooms in the Tertiarty Treatment Building.

10. Sprinkler Head Guards: Provide head guards on all sprinkler heads within seven feet-zero inches of any floor and/or under stairs, and elsewhere where susceptible to accidental damage. Guards shall be constructed of galvanized wire with locking device to permit authorized removal for sprinkler and head repair. Do not provide guards on sidewall heads.

11. Spare Heads Cabinet: Provide metal cabinet with extra sprinkler heads and two sprinkler head wrenches for each type of head adjacent to each alarm check valve riser. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

G. Valves:

1. NFPA 13. Provide valves of types approved for fire service. Gate valves shall open by counterclockwise rotation. Provide an OS&Y gate valve beneath each alarm check valve.

a. Gate Valves 2 1/2-Inch and Larger: Outside screw and yoke indicating type, iron body, bronze mounted gate valves, straightway pattern, flanged ends, 175 psig working water pressure.

b. Gate Valves 2-Inch and Smaller: Outside screw and yoke indicating type, bronze body, straightway pattern, screwed ends, 175 psig working water pressure.

c. Butterfly Valves: Indicator type, built-in double pole/double throw tamper switch, 175 psig working water pressure. Butterfly valves of sizes up to six-inch shall have locking type handles. Butterfly valves of eight-inch size shall have gear operators. Butterfly valves may be substituted for gate valves except where NFPA/UL specifically requires an outside screw and yoke gate valve.

d. Ball Valves Three-Inch and Smaller: Brass body, chrome plated brass ball with nylon seat, cadmium plated vinyl insulated handle, female NPT inlet and outlet, 600 psig working water pressure.

e. Check Valves 2 1/2-Inch and Larger: Iron body, bronze mounted, flanged ends, swing type for placement in the horizontal position, 175 psig working water pressure. Provide flanged inspection and access cover plate for check valves four-inch and larger.

f. Check Valves Two-Inch and Smaller: Iron body, stainless steel trim, EPDM seal, screwed ends, silent check type, 200 psig working water pressure.

g. Drain and Inspectors Test Valves: Bronze globe valve with integral bronze seat, renewable disc, union bonnet, inside screw rising spindle, suitable for 300 psig non-shock cold water.

h. Automatic Ball Drip Valve: 1/2-inch, bronze body, corrosion resistant metal ball and spring, threaded ends, 175 psig working water pressure.

H. Alarm Check Valves:

1. Provide alarm check valves complete with variable pressure retarding chamber, alarm test valve, alarm shutoff valve, check valves, drain valves, pressure gages, and all other appurtenances for the proper operation of the system.

I. Riser Check Valves:

1. Provide riser check valves complete with alarm test valve, drain in valve, pressure gages, and all other appurtenances for the proper operation of the system.

J. Fire Department Connections:

1. Provide listed and approved 4-inch single Storz type connections or 4 x 2 1/2 x 2 1/2-inch siamese type connections as required by the local fire department. Fire department connections shall have hose threads to suit local fire department with brass pin lug caps and chains, and identifying fire department connection escutcheon plate. Provide polished chrome plated finish.

K. Sight Drains:

1. Reliable Model B, one inch, to suit.

L. Backflow Preventers:

1. Provide listed and approved double check backflow preventer with OS&Y gate valve on both ends and strainer on inlet. Body shall be epoxy coated cast iron with rubber check valve disks, bronze seats, stainless steel trim, and bronze test cocks. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR. Listing of the specific make, model, design, and size in the FCCCHR shall be acceptable as the required documentation." Double check backflow preventers shall be tested and certified under ASSE 1015.

2. Provide strainer without screen.

3. For backflow preventer testing, provide downstream of the backflow prevention assembly UL 668 hose valves with 2 1/2-inch National standard male hose threads with cap and chain.

M. Pressure Gauges:

1. Pressure gauges shall be listed and approved for fire protection service, ASME B40.1, three percent accuracy or better, with wetted parts consisting of bronze bourdon tube and brass socket. The movement shall be designed to provide shock and vibration resistance. Gauges shall withstand temperatures of -40 to 150 degrees Fahrenheit.

2. Gauges shall have a minimum 2 1/2-inch diameter face. Dial gradations reading in "PSIG" shall be such that the normal operating pressure of the system installed shall be indicated near the middle of the scale.

3. Select gauges for use on "wet" systems with pressurized water piping.

4. Gauges shall be equipped with a ball valve shutoff and snubber. An outlet, at least 1/4 inch in diameter, plugged for the installation of the inspector's gauge shall be located between each valve and gauge.

N. Alarm Systems

1. Audible Alarms:

a. Provide electric alarm bells of the approved weatherproof and guarded type. Mount alarms outdoors on the exterior walls of each building at the location(s) indicated. Bells shall sound locally upon the flow of water in each corresponding sprinkler system. Electric alarm bells shall operate on 24 VDC power unless other voltage is required by the fire alarm system. Bell shall be eight-inch size with weatherproof backbox for outdoor installation.

2. Alarm Initiating Devices:

a. Provide switches with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system and electric alarm bell where so indicated. Connection of switches to the fire alarm system shall be under Section 28 31 00 – Fire Detection and Alarm. Switches shall be listed and approved. Do not install a shutoff valve in the piping between the alarm check valve and any pressure switch.

b. Pressure Switches: Provide pressure-actuated adjustable switches designed for use in wet-pipe automatic fire sprinkler systems which shall actuate at four to eight psig. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for the automatic transmittal to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and be designed for upright mounting (threaded connection down) either indoors or outdoors. Potter-Roemer PS10A Series, Reliable, Gem, Autocall, or equivalent acceptable product.

c. Low Water Pressure Supervisory Switches: Provide pressure actuated adjustable switches designed for use in automatic fire sprinkler systems water supply piping which shall actuate by a low pressure supervisory signal as indicated. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for the automatic transmittal to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant cover and be designed for upright

mounting (threaded connection down) either indoors or outdoors. Potter-Roemer PS40 series, Reliable, Gem, Autocall, or equivalent acceptable product.

d. Flow Switches: Provide vane-type water flow switches designed for use on Schedule 10 to Schedule 40 steel pipe in wet-pipe automatic fire sprinkler systems. Each flow switch shall be equipped with plastic paddle. Alarm actuating device shall detect a flow of 10 gallons per minute or more, and have mechanical diaphragm controlled retard device adjustable from 10 to 90 seconds and shall instantly recycle. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for wiring to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and be designed for vertical or horizontal mounting either indoors or outdoors. Potter-Roemer VSR-F Series, Gem, Reliable, Autocall, or equivalent acceptable product. Flow switches shall be sized for the piping in which installed to ensure proper fit.

3. Tamper (Supervisory) Switches: Provide on all control valves, closed circuit supervisory tamper switches mounted in accordance with UL standard. Provide supervision against valve closure or tampering of valve. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for wiring to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. A signal shall be initiated during the first 1/5 of travel distance of the valve/stem from the full open position. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and shall be suitable for indoor installation, and have sealed and gasketed enclosures. Potter-Roemer OSYSU Series, Gem, Reliable, Autocall, or equivalent acceptable product.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Pipe Hangers and Supports:

1. Provide in accordance with NFPA 13.

2. Attach to steel joists with MSS SP-58, Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

3. Hangers, supports, rods, and fasteners shall be Series 300 stainless steel.

B. Supplementary Steel Channels:

1. Unless otherwise indicated on the Structural Drawings, provide all supplementary steel and factory fabricated channels required for proper

installation, mounting, and support of all equipment and systems provided under this Section.

2. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

3. All supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be series 300 stainless steel.

C. Pipe Sleeves:

1. Sleeves in Masonry and Concrete Walls, Floors: Schedule 40 series 300 stainless steel. Where sleeves are cast into new concrete, sleeves shall be Standard Weight series 300 stainless steel, have two-inch high annular ring water stop continuously welded all around the pipe sleeve.

2. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and stainless steel hardware.

D. Identification Signs:

1. Signage shall be safety sign manufacturer standard signs furnished and installed under this Section. Comply with NFPA 13. Attach properly lettered and approved metal signs to each audible alarm, control valve and test valve. Permanently affix hydraulic design data nameplates to the riser of each system.

E. Shop Painting:

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, a high solids epoxy with the following characteristics:

a. Solids by Volume: Minimum 69% (percent $\pm$2).

b. Type: Polyamidoamine, self-priming.

c. Dry Film Thickness: 4-8 mils per coat.

d. No. of Coats required: Two.

e. V.O.C. Requirement: 2.79 max.

f. Color: Safety Red.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements:

1. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.02 INSTALLATION

A. Install water based fire-suppression system as shown on the Contract Drawings. The Contract Drawings are generally diagrammatic and installation of the system in the allotted spaces shall be verified.

B. Manufacturer's Instructions:

1. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the Project.

C. General Installation Requirements:

1. Install water based fire-suppression system in complete accordance with NFPA 13 and the approved Shop Drawings.

2. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Fire Protection Subcontractor's expense.

3. All piping shall be run as close as possible to structural members, walls, and ceilings.

4. Where existing walls or floors must be penetrated, Contractor shall neatly cut the required openings and patch the existing work to provide a neat and finished appearance.

5. Sleeves:

a. Caulk sleeves airtight with fire resistant sealant between sleeve and ductwork in accordance with the Contract Documents.

D. Avoid Interferences With Other Trades Installation

1. Installation, workmanship, inspection, and testing shall be in accordance with NFPA 13 and NFPA 24, with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other accepted methods. When Work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Provide Teflon pipe thread paste on male threads.

2. Piping shall not be permitted in Electrical Rooms unless otherwise indicated.

3. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

4. Install aboveground pressurized piping to permit draining of all sections of each piping systems without traps. Pitch piping back to system low points. Provide drain valves at all piping low points.

5. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment, and structure.

6. Piping, General: Determine and establish measurements for piping at job Site. Cut pipe to actual dimensions and assemble to prevent residual stress. Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted. Within buildings, run piping parallel to structure lines.

7. Sprinkler Heads Locations:

   a. Sprinkler heads and piping locations shall be determined by actual field measurements. Care shall be taken to avoid obstruction of structural members, equipment, fixtures, lighting, ducts, other piping, ceiling tile supports, etc.

E. Test Connections:

1. Inspector's Test Connections: Provide inspector's test valve approximately six feet above the floor in readily accessible location for each sprinkler system or portion of each sprinkler system equipped with a flow or pressure switch. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to a floor drain shall be permitted only if the drain is sized to accommodate full flow. Discharge to a sump shall be permitted only if the sump pump is permanently installed and activates automatically. Discharge to janitor sinks or similar fixtures shall not be permitted. Provide smooth bore corrosion resistant discharge orifice of same size as corresponding sprinkler orifice giving flow equivalent to one sprinkler.

2. Backflow Preventer Test Connection: Provide test valves downstream of the backflow preventer assembly. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads "Test Valve.".

F. Main Drains:

1. Provide separate drain piping to discharge at safe points outside each building or to sight drains or indirect wastes attached to building drains of adequate size to readily receive the full flow from each drain under maximum available system pressure. Indirect wastes shall be arranged for readily visible observation of flow. Provide auxiliary drains as required by NFPA 13. Main drain pipe and valve shall support full flow at system demand.

G. Pipe Hangers and Supports:

1. The hanging and supporting of all piping and equipment shall conform to the requirements of NFPA 13 and the manufacturer's recommendations.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and contraction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers will be six inches clear from other piping, hangers, conduits, lighting fixtures, equipment, ductwork, and other obstructions.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Contract Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Seismic Pipe Hanging Requirements:

    a. Seismic protection of all fire suppression piping shall comply with the requirements of NFPA 13. Seismic bracing shall be provided for all piping larger than or equal to 2 1/2 inches. All feed mains regardless of size shall be braced.

    b. The Contractor shall have the option of substituting alternate seismic supports and anchors, provided their submittals are accompanied by Shop Drawings signed and sealed by the Fire Protection Engineer and a certified letter stating that anchor calculations were performed by a licensed professional Structural Engineer registered in the State of New York. Do not submit calculations.

    c. All mechanical materials and equipment, including all pipes, shall be supported and anchored to resist the external seismic forces. Force shall be resisted without failure or permanent displacement when it is applied in any direction, and shall conform to the specified Building Code. Site seismic criteria can be found on Drawing SG-002.

    d. The ends or all branch lines shall be provided with an acceptable method of lateral restraint. The use of a wrap around "U" hanger, or band hanger at 45 degree angle, is acceptable.

    e. Acceptable manufacturers of seismic bracing are: TOLCO Incorporated; Corona, California.

    f. All seismic braces shall be Listed for tension and compression service.

    g. All braces shall utilize ordinary black steel piping as the prime support member.

    h. Structural connection:

1) All bracing shall be connected to the building's structural members.

2) All means of connection to the building's structure and sprinkler pipe shall be Listed for the intended use.

3) At a minimum, the bracing shall be provided a maximum of 40 feet between lateral braces and 80 feet between longitudinal braces. However, if the pipe installation positioning selected by the Contractor requires additional bracing, these locations and types of braces shall be submitted for review and shall be provided as part of the base bid.

H. Pipe Through-Penetrations:

1. Provide pipe sleeves where pipe passes through walls, floors, ceiling, roofs, and partitions. In new construction, sleeves will be installed and secured in proper position and location during construction by the trade whose element will be penetrated. Such trades include concrete, masonry, drywall, and/or plaster in the case of framed construction. In existing construction, pipe sleeves shall be furnished and installed under this Section. Core drilled holes in masonry and concrete may be provided by this Section in lieu of pipe sleeves, however cored drilled holes in masonry shall have cavities completely grouted smooth under this Section. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.

2. Pipe Penetrations Through Building Exterior Construction: Provide a mechanically adjustable segmented elastomeric seal, with sleeve sized as recommended by seal manufacturer.

3. Pipe Penetrations Through Building Interior Construction: Provide not less than 1½-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with rock wool insulation.

a. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone.

b. Seal both ends of penetrations through fire rated assemblies to maintain fire resistive integrity with UL listed fill, void, or cavity material. Install firestopping assembly in accordance with UL FRD systems, and as recommended by manufacturer. Completely fill voids flush with the surface. Firestopping for filling voids in floors in which the smallest dimension of a void is four inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed firestoppings shall be replaced with new firestoppings as specified in this Section.

4. Extend sleeves in floor slabs two inches above the finished floor. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

5. Seismic-braced pipe:

a. Proper clearances between penetrating sprinkler system piping, including drains and fire department connections, and any barrier shall be provided. The penetration holes shall be sized such that the hole diameter is two inches larger for pipe diameters one-inch nominal to three and a half-inch nominal, and four inches larger for four-inch and larger nominal diameter pipe.

b. All open space around seismically braced through-penetrations shall be protected by a Listed, flexible through-penetration seal system.

I. Cross Connections and Interconnections:

1. No equipment, devices or piping shall be installed which will provide a cross or interconnection between a distribution water supply and a drainage, soil, or waste pipe which will permit or make possible the backflow of sewage, polluted water, or waste into the water supply system.

3.03 FIELD TESTING / QUALITY CONTROL

A. Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.

B. After system installation has been completed and prior to initial operation, inspect piping and control wiring systems for compliance with Drawings, Specifications, and accepted submittals. Perform flushing and tests in compliance with NFPA 25 with the additions specified herein. Have piping tested, and approved by the Fire Protection Engineer, before concealing.

C. Test Procedures and Reports:

1. Test each new system to demonstrate compliance with the contract requirements. Tests shall be witnessed by the Engineer. Correct defects in the Work and repeat tests until Work is in compliance with contract requirements.

2. Prepare and submit procedures for all specified tests to the Engineer for acceptance prior to the planned preliminary tests. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case.

3. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide water, electricity, instruments, appliances, equipment, connecting devices, and personnel for the tests.

4. Gages used in pressure tests shall have been calibrated within the six-month period preceding the tests. Leaks found during tests shall be repaired by

replacing pipe and/or fittings and the system retested. Caulking of joints shall not be permitted.

5. Repair defects disclosed by tests or, if required by the Engineer, replace defective Work with new Work without additional cost. If any deficiencies are revealed during tests, such deficiencies shall be corrected and the tests reconducted at no additional cost.

6. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing design deficiencies. State that no deficiencies are evident if that is the case.

7. When tests have been completed and corrections made, submit signed and dated test reports.

D. Preliminary Tests:

1. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide water, electricity, instruments, connecting devices, and personnel for the tests. Correct defects in the Work and repeat tests until the Work is in compliance with contract requirements.

2. Perform pressure tests as specified herein. Prior to application of test pressure, remove or valve off piping components which may be damaged by tests and install a calibrated pressure gage in each system. In the event of leakage, locate and repair leaks by remaking joints and/or replacing piping sections and repeat the test. Pressure test each system hydrostatically at 200 psig for a two hour period with no leakage or reduction in pressure.

3. Provide alarm tests for each alarm initiating device and audible alarm. Test the audible alarms by flowing water through the inspector's test connection.

4. Provide flow tests for each riser, backflow preventer, and zone.

E. Backflow Preventers Test:

1. Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Engineer prior to placing the fire water system into operation.

F. Formal Tests and Inspections:

1. Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and accepted. Submit a written request for formal inspection at least 15 days prior to inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat any or all of the specified preliminary tests. Correct defects in Work and repeat tests until Work is in compliance with contract requirements. Furnish equipment, water, electricity, instruments, connecting devices, and personnel for performing tests. The Authority Having Jurisdiction shall witness formal tests and approve systems before they are accepted. When tests have been

completed and corrections made, submit a signed and dated test report, similar to that specified in NFPA 13.

G. Flushing:

1. After completion of testing and before placing in operation, flush all new sprinkler piping in accordance with Factory Mutual Loss Prevention Data Sheet 2-81, Fire Protection System Inspection, Testing and Maintenance, Section 3.1.5 using the hydraulic method. Use the permanent fire water service at its maximum available pressure for the source of flushing water. Flush piping through each sprinkler head outlet before sprinkler heads are installed. Flush until water runs clean. Discharge used water to sanitary sewer.

3.04 STARTUP / DEMONSTRATION

A. Disinfection:

1. Prior to placing the potable water systems in service, they shall be disinfected in accordance with AWWA Standard C601, Section 33 01 10.60, Disinfection, and any additional requirements prescribed by the public health authorities having jurisdiction.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning:

1. Remove debris and waste materials resulting from installation.

B. Painting:

1. Surface Preparation and Shop Painting:

a. Clean and prime coat ferrous metal surfaces of equipment in the factory/shop in accordance with the requirements of Section 09 91 00 – Painting.

b. Coat polished and non-ferrous metal surfaces with corrosion prevention compound, which shall be maintained during storage and until equipment begins operations.

2. Field Painting:

a. Painting required for exterior surfaces of ductwork and insulation, and finish painting of items only primed at the factory, are specified in Section 09 91 00 – Painting.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 22 07 00- PLUMBING PIPING INSULATION
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all Plumbing Piping Insulation, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

C. All Plumbing Piping Insulation shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	ASTM	American Society for Testing Materials
2.	NFPA	National Fire Protection Association
3.	UL	Underwriters Laboratories

B. Reference Standards:

1.	ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
2.	ASTM A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications
3.	ASTM B209	Standard Specification for Aluminum and Aluminum – Alloy Sheet Plate
4.	ASTM C195	Mineral Fiber Thermal Insulating Cement
5.	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
6.	ASTM C534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
7.	ASTM C547	Mineral Fiber Pipe Insulation
8.	ASTM C552	Cellular Glass Thermal Insulation
9.	ASTM C553	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
10.	ASTM C591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
11.	ASTM C592	Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
12.	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
13.	ASTM C916	Standard Specification for Adhesives for Duct Thermal Insulation
14.	ASTM C1126	Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
15.	ASTM C1136	Flexible, Low Permeance Vapor Retarders for Thermal Insulation
16.	ASTM E84	Surface Burning Characteristics of Building Materials
17.	ASTM D1784	Standard Specification for Rigid Poly Compounds and chlorinated Poly Compounds

18.	NFPA 225	Method for Test Surface Burning Characteristics of Building Materials
19.	UL 723	Test for Surface Burning Characteristics of Building materials

1.05 DESCRIPTION

A. This Section includes requirements for providing Plumbing Piping Insulation and accessories in accordance with applicable standards and regulations. In addition:

1. Plumbing Piping Insulation shall be furnished complete with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances
    a. Building Code of the City of New York.
    b. New York State Uniform Fire Prevention and Building Code.

A. Qualifications of Installer:

1. Prior to installation, submit data showing the name and license of the installing contractor and that he has successfully installed systems of the same type and design as specified herein. Data shall include names and locations of at least two installations of such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. The installing contractor shall be licensed to perform applicable insulation installation in the state of New York.

B. Qualifications of Manufacturer:

1. All components of the Plumbing Piping Insulation shall be provided by the Contractor through a single Plumbing Piping Insulation vendor.
2. The Plumbing Piping Insulation shall be standard of the manufacturer.
3. The Plumbing Piping Insulation shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall be as shown on the Contract Drawings.
4. All Plumbing Piping Insulation shall be selected Based on the required design parameters and installed on piping as indicated by the Contract Drawings.

5. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Product Data- Annotate descriptive data to show the specific manufacturer, material and specifications, thicknesses, etc. of each item.
2. Piping insulation and jackets
3. Domestic water heater vent insulation
4. Equipment insulation [**and boxes**]
5. Adhesives, sealants, and coating compounds
6. Accessory materials
7. Certificates and Licenses
    a. Qualifications of installer
8. Action Submittals:
    a. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.
    b. Details of corrosion resistance coating.
    c. Detailed specifications and data sheets for all accessories.
    d. Shop and field testing procedures.
    e. Deviations from the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the Plumbing Piping Insulation for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The Plumbing Piping Insulation shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.
2. The Plumbing Piping Insulation shall be protected from corrosion and deterioration and shall be stored in a dry area.
    a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plumbing Piping Insulation

1. Johns Manville, Denver, CO;
2. Knauf Insulation, Shelbyville, IN;
3. Owens Corning, Kearny, NJ;
4. Armacell, Chapel Hill, NC;
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Packaging and Labeling

a. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to Project Site shall have manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation materials shall be asbestos-free.

2. Surface Burning Characteristics

a. Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84, or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

3. Recycled Materials

a. Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this Section. The minimum recycled material content of the following insulation types are:

1) Rock Wool: 75 percent slag of weight

2) Fiberglass: 20 to 25 percent glass cullet by weight

3) Phenolic Rigid Foam: 5 percent recovered material

4) Plastic Rigid Foam: 9 percent recovered material

5) Polyiscocyanurate/Polyurethane: 9 percent recovered material

6) Rigid Foam: 9 percent recovered material

B. Insulation material shall conform to Table 22 07 00-1. Insulation thickness shall be as listed in Table 22 07 00-2. Insulate all piping listed in these tables. Where piping is located in unheated spaces such as attics and crawl spaces, provide insulation thickness one inch thick greater than indicated in Table 22 07 00-2. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

C. Fittings Insulation:

1. Factory premolded insulation inserts for pipe fittings, flanges, and valves shaped to fit the specific fitting to be insulated. Inserts shall be of same material as the straight pipe. Inserts shall be of same thickness as the straight pipe insulation.

D. Piping Insulation Jackets:

1. All-Purpose Jackets:

a. Insulation manufacturer's standard reinforced fire retardant jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

E. PVC Jackets:

1. ASTM D1784 polyvinyl chloride (PVC) jackets, and factory premolded PVC fitting covers, UV-resistant, gloss white finish. Provide compatible vapor barrier tape.

2. Metal Jackets:

a. Aluminum Jackets: ASTM B209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches (DN 200). Provide corrugated surface jackets for jacket outside diameters 8 inches (DN 200) and larger. Provide stainless steel bands, minimum width of 1/2-inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

b. Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2-

inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and materials as jackets on adjacent piping.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Adhesives, Sealants, and Coating Compounds:

1. Insulation and Vapor Barrier Adhesive: ASTM C916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

2. Lagging Adhesive: Fire resistant, for pipe and duct insulation.

a. Provide appropriate class recommended by insulation manufacturer for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation.

b. Provide appropriate class for attaching fibrous glass insulation to metal surfaces.

3. Mineral Fiber Insulation Cement: ASTM C195.

4. Vapor Barrier Coating: Provide in accordance with insulation manufacturers' recommendations.

5. Weatherproof Coating: For outside applications, provide in accordance with insulation and jacket manufacturer's recommendations.

6. Flexible Cellular Insulation Adhesive: Air-drying contact adhesive for joining insulation longitudinal seams and butt joints.

7. Flexible Cellular Insulation Coating: Water-based latex enamel for protective finish. Do not use vinyl lacquer finish or equivalent.

B. Accessory Materials:

1. Staples: ASTM A167, Type 304 or 316 stainless steel outside-clinch type.

2. Insulation Bands: 1/2-inch wide; 26 gage stainless steel.

3. Metal Bands: 3/8-inch minimum width

4. Fibrous Glass Cloth and Tape: 20 by 20 maximum size mesh. Tape shall be 4 inches wide rolls. Tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

5. Wire: Soft annealed stainless steel.

6. PVC Pipe Fitting Cover and Its Vapor Barrier Tape: Provide PVC fitting covers with insulation inserts of same material and thickness as pipe insulation.

7. Vapor Barrier Materials: ASTM C1136. Resistant to flame, moisture penetration, and mold growth, color white.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All Plumbing Piping Insulation shall be as efficient as those Plumbing Piping Insulation that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.

2. The licensed Professional Engineer shall sign and seal all shop test reports.

a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.

2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install Plumbing Piping Insulation in complete accordance with the manufacturer's printed installation instructions and the approved Shop Drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

B. Insulation (Except Flexible Cellular and Calcium Silicate Insulation):

1. Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over four inches on center and 1/2-inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than three inches wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

2. Vapor Barrier Jacket: When a vapor barrier jacket is required on ends of sections of insulation that butt against flanges, unions, valves, fittings, and

joints, provide a vapor barrier coating, or manufacturer's weatherproof coating for outside service, unless pipe insulation is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1-1/2 inches past the break in both directions. At penetrations by pressure gages, thermometers, etc. fill voids with vapor barrier coating for outside service. Seal with a brush coat of the same coating.

3. Roof: Where pipe penetrates the roof, insulate piping to a point flush with top of flashing and seal with vapor barrier coating. Butt top of flashing and interior insulation tightly to exterior insulation. Extend exterior metal jacket two inches to fold down beyond end of insulation. Seal flashing and counterflashing underneath with vapor barrier coating.

C. Flexible Cellular Insulation:

1. Do not use flexible cellular insulation for pipes in fire rated chases and inside fire walls.

2. Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide insulation inserts and metal jackets. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of finish as recommended by insulation manufacturer to flexible unicellular insulation in outside locations. Do not use vinyl lacquer finish or equivalent. Provide flexible cellular insulation for outdoor use with ultraviolet (UV) resistant coating.

D. Cellular Glass and Calcium Silicate Insulation:

1. Provide in accordance with manufacturer's printed instructions.

E. Piping Insulation Jackets:

1. All-Purpose Jackets:

a. Provide all-purpose jackets and PVC fitting covers for all piping except as otherwise specified herein.

2. Polyvinyl Chloride (PVC) Jackets:

a. Provide PVC jacketing system to cover all straight runs, pipe fittings, flanges and valves of services to be insulated. Do not provide PVC jacketing where exposed to weather. Provide PVC jacketing only in ambient temperatures below 150 degrees Fahrenheit. Do not provide PVC jacketing at insulated pipe through-penetrations.

b. Secure jacketing with stapling, with metal or plastic tacks made for securing PVC jackets, or with jacket manufacturer's solvent welding adhesive to seal all lap joints in the system. For services where

vapor barrier is required, provide vapor retarder mastic compatible with PVC as recommended by the jacket manufacturer applied over all lap joints in the jacketing system, or provide taping with PVC vapor barrier tape. Provide factory prefabricated PVC covers for insulation on fittings, valves, and flanges.

3. Metal Jackets:

   a. Provide metal jacketing system to cover all straight runs, pipe fittings, flanges and valves of services to be insulated where exposed to weather or exposed to ambient temperatures 150 degrees Fahrenheit and above, and for piping located less than seven feet-0 inches above the floor. Provide metal jacketing at insulated pipe through-penetrations.

   b. Provide stainless steel bands to secure jackets to insulation. Provide factory prefabricated metal covers for insulation on fittings, valves, and flanges.

F. Hangers and Anchors:

1. Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields or protection saddles as indicated.

2. Where shields are used on pipes two inches (DN 50) and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, molded glass fiber, rigid foam or other approved material, all minimum 15 pounds per square inch compressive strength, of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable.

3. Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe. Protection saddles shall not be used on piping carrying medium less than 60 degrees Fahrenheit unless otherwise indicated.

4. Where anchors are secured to piping carrying medium less than 60 degrees Fahrenheit that is to be insulated, insulate anchors the same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

G. Through-Penetrations:

1. Where interior wall is penetrated, extend a metal jacket two inches out on either side of wall and secure on each end with a metal band. Where floor is penetrated, extend a metal jacket from a point below the floor slab to a point 10 inches above floor with one metal band at the floor and one not more than one inch from end of metal jacket. Where exterior wall is

penetrated, extend metal jacket through sleeve to a point two inches beyond interior surface of wall.

2. Provide insulation inserts beneath the metal jacket. Insulation inserts shall be of calcium silicate or cellular glass of the same thickness as adjacent insulation. Insulation inserts shall cover full pipe circumference and be not less in length than the metal jacket. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating.

H. Flanges, Unions, Valves, and Fittings for Piping:

1. Factory fabricated removable and reusable insulation inserts shall be used. When nesting size insulation is used, overlap two inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2-1/2 inches, elbows insulated using insulation segments shall not have less than three segments per elbow. Place and join segments with manufacturer's recommended water-vapor resistant, fire retardant adhesive appropriate for the temperature limit of the service. Overlap tape seams one inch. Total dry film thickness shall be not less than 1/16-inch. Unions are not to be insulated; taper insulation to union at a 45-degree angle.

2. Provide finish of one of the following:

a. PVC Fitting Covers: Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather.

b. Metal Jacket Fitting Covers: Secure covers with stainless steel bands. Provide minimum two bands per fitting cover unless more are prescribed per manufacturer instructions.

c. Coating with Embedded Glass Tape: Coating with Embedded Glass Tape may be provided in lieu of PVC Fitting Covers. Coat insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. Total dry film thickness shall not be less than 1/16-inch. For cold piping, seal insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before Plumbing system operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all Plumbing Piping Insulation for their intended use.

B. Protection:

1. The Plumbing Piping Insulation shall be protected as per the requirements of the Contract Documents. The use of Plumbing Piping Insulation shall not be permitted until permission is given by the Engineer.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed Plumbing Piping Insulation and remove all debris and waste materials resulting from installation.

TABLE 22 07 00 -1
INSULATION MATERIAL FOR PIPING

Service	Material	Spec	Type	Class	Vapor Barrier Required
Plumbing Domestic Hot Water Piping (Maximum 200 degrees°F)	Mineral Fiber	ASTM C547		1	No
Plumbing Domestic Cold Water Piping and Service Water Piping	Mineral Fiber	ASTM C547		1	Yes
Water Cooler Drain Piping (to sewer tie in)	Mineral Fiber	ASTM C547		1	Yes
Roof/Hatch Drain Bodies and Horizontal Piping	Mineral Fiber	ASTM C547		1	Yes

TABLE 22 07 00 -2 PIPING INSULATION THICKNESS (INCHES)			
		Tube and Pipe Size (Inches)	
Service	**Material**	**1/4 to 1-1/4**	**1-1/2 to 6**
Plumbing Domestic Hot Water Piping (Maximum 200°F)	Mineral Fiber	1	1-1/2
Plumbing Domestic Cold Water Piping and Service Water Piping	Mineral Fiber	1/2	3/4
Roof/Hatch Drain Bodies and Horizontal Piping	Mineral Fiber	-	3/4

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 22 10 00 – PLUMBING PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required to furnish, install, and test all plumbing fixtures, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	9
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	12

C. Plumbing fixtures shall be as indicated in the Plumbing Fixture Schedule as shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 29 13 – Enclosed Controllers

B. Section 33 01 10.60 – Disinfection of Piping

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	ARI	American Refrigerating and Air
2.	CABO	Council of American Building Officials
3.	GPF	Gallons per Flush
4.	USCS	U.S. Department of Commerce Commercial Standard

B. Reference Standards:

1.	ASME A112.6.1M	Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2.	ASME A112.18.1M	Plumbing Fixture Fittings.
3.	ASME A112.19.1M	Enameled Cast Iron Plumbing Fixtures.
4.	ASME A112.19.2M	Vitreous China Plumbing Fixtures.
5.	ANSI A112.19.5	Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).
6.	ANSI Z358.1	Emergency Eyewash and Shower Equipment.
7.	ANSI/ARI 1010	Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.
8.	ANSI/CABO A117.1	Accessible and Usable Buildings and Facilities.
9.	U.S. Department of Commerce Commercial Standard.	
10.	New York City Building Code.	

1.05 DESCRIPTION

A. This Section includes requirements for providing plumbing fixtures in accordance with applicable standards and regulations. In addition:

1. Plumbing fixtures shall be furnished complete with all accessories, attachments, fastenings, and other appurtenances as specified and/or as may be required for a satisfactory installation.
2. Plumbing fixtures shall be of the water conservation type and shall conform to the requirements of the New York City Building Code.
3. Plumbing fixtures for use by the physically handicapped shall be in accordance with ANSI/CABO A117.1.

B. All plumbing fixtures are to be white vitreous china unless otherwise specifically noted. Where enameled iron fixtures are specified, they shall be furnished with acid resisting enamel.

1.06 QUALITY ASSURANCE

A. The Contractor shall be a New York City licensed plumber.

B. All plumbing fixtures and fittings proposed shall be one of a single manufacturer and of similar character in any room or location; escutcheons, handles, etc., on the different fixtures shall be of the same design.

C. All plumbing fixtures shall be "First Quality" as defined and set forth in Commercial Standard CS77-28 as promulgated by the U.S. Department of Commerce.

D. Plumbing fixtures shall be as efficient as those fixtures that have been tested to perform satisfactorily for at least two (2) years.

E. All wall hung fixtures shall be adequately supported from the floor with fixture support carriers. Floor mounted fixtures shall be installed as per manufacturer instructions.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Provide catalogue cuts of all plumbing fixtures, showing: sizes, rough-in dimensions, utility sizes, faucets, drains, carriers, flush valves, trim and finishes, and any electrical requirements.

b. Complete assembly, layout required clearances, and installation drawings, all with clearly marked dimensions.

c. Provide a list of manufacturer's recommended special tools and spare parts to be supplied.

d. Operation and Maintenance Manuals: Submit operation and maintenance manuals for plumbing fixtures, faucets, drains, mixing valves, flush valves, carriers, assembly of parts list for flush valves, signage, emergency equipment and electric water coolers as required in accordance with the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation and packing of the plumbing fixture for shipment shall be in accordance with the manufacturer's commercial practice subject to the approval of the Engineer.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Plumbing fixtures shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.
2. Plumbing fixtures shall be protected from corrosion and deterioration, and plumbing fixtures shall be stored in a dry area.
    a. Plumbing fixtures stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.
3. Plumbing fixture interiors shall be kept free from dirt and foreign matter.
4. Plumbing fixtures shall be properly protected from damage during construction, and shall be cleaned in accordance with manufacturer's instructions prior to installation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the products provided under this Section, and as per the requirements of the Contract Documents. In addition:
    1. Furnish the following spare parts:
        a. One (1) set of faucet washers per three (3) faucets.
        b. One (1) flush valve service kit per three (3) flush valves.

B. Tools: Provide standard and special tools as well as supplies necessary to service, disassemble, repair, and adjust the products.

1.10 WARRANTY

A. Electric water cooler(s) provided under this Section shall be covered by a five (5) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100 percent of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Service Sinks (Item No. SS-1):
    1. Kohler Company, Kohler, WI;
    2. Watts Water Technologies, Inc., North Andover, MA;
    3. Or approved equal.

B. Emergency Eyewash and Showers:
    1. Emergency Eyewash and Drench Hose (Corrosion Resistant): ESD-1:
        a. Model No. 8905, as manufactured by Haws Drinking Co., Lane Sparks, NV;

b. Model No. SE-925 as manufactured by Speakman Co., New Castle, DE;

c. Model No. G5026 as manufactured by Guardian Equipment Co., Chicago, IL.

d. Or approved equal.

2. Flow Switches, Audible and Visible Alarms:

a. Haws Drinking Co., Lane Sparks, NV;

b. Speakman Co., New Castle, DE;

c. Or approved equal.

C. Emergency Shower and Eyewash Station Tempering Valves:

1. Model 911 as manufactured by Lawler Manufacturing Co., Edison, NJ;

2. Model TM-800 as manufactured by Leonard Valve Co., Cranston, RI;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. All fixtures shall be white.

B. All plumbing fixtures shall be of high quality and shall be manufactured from the following materials:

1. Vitreous china shall be non-absorbent, hard-burned, and vitrified throughout the body.

2. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces.

3. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head, face plates, and pop-up stoppers of lavatory waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS), or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than two (2) years.

a. Plastic in contact with hot water shall be suitable for 180 degrees Fahrenheit (82.0 degrees Celsius) water temperature.

C. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.

1. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap.

2. Faucets shall have chrome plated flexible tube risers with loose key operated shutoff valves.

3. All exposed traps shall be cast brass swivel chromium plated, grounded joint, and with cleanout.

4. Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.

D. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports.

E. Service Sinks:

1. Item No. SS-1:

a. Type: Wall mounted, enameled cast iron sink.

b. Accessories:

1) Faucet with vacuum breaker shall be equal to Kohler Co. brand spill resistant vacuum breaker shall be closed by ambient air pressure when water flow is off.

2) Wall carrier shall be equal to WATTS® brand, three-bolt floor mounter service sink carrier with epoxy coated steel uprights, welded feet, and cast-iron fitting.

3) P-Trap shall be equal to Kohler Co. brand polished chrome P-Trap with adjustable rotation and slit joint inlet with cleanout plug and strainer.

4) Rim guard shall be equal to Kohler Co. brand stainless steel coated wire.

5) Fitting shall be wall mounted, mixing faucet type with integral stop, vacuum breaker, pail hook, and adjustable top brace. Finish shall be polished chrome.

F. Emergency Eyewash and Showers:

1. Emergency Eyewash and Drench Hose (Corrosion Resistant): ESD-1:

a. Type: Wall mounted corrosion resistant emergency eyewash station with drench hose.

b. Materials:

1) Eye/Face-Wash:

a) Twin Buna-N covered ABS heads.

b) Stainless steel ball valve, stay open type.

2) Drench Hose:

a) Minimum eight foot flexible reinforced PVC hose.

3) Pipe:

a) All PVC parts shall be Schedule 80.

b) Painted green with bright yellow marking.

4) Supply: 1¼-in. PVC.

c. Anchor water supply to construction.

d. Eyewash and drench hose must conform to ANSI Z358-1-1998 standards.

2. Flow Switches, Audible and Visible Alarms:

a. Type:

1) Single pole double throw.

2) NEMA 4X.

3) UL listed paddle type flow switch.

4) Contacts to be rated for 5 amps at 120 vac.

b. Emergency flow switch equipment shall be nominal 120 vac, 1 phase, 60 Hz electrical service, in accordance with Section 26 29 13 – Enclosed Controllers.

c. Flow switches shall only be furnished by emergency shower and eyewash manufacturer for each shower and/or eyewash station to ensure compatibility of the flow switch operating in conjunction with the shower or eyewash operation, or operation of both units. If flow switch is not furnished by the shower and eyewash manufacturer, the Contractor shall assume complete responsibility for the proper operation of the flow sensing of the eyewash and shower units, which shall include all additional conduits, wires, and appurtenances; and operation of flow switches shall be as stated below.

d. Flow switches shall sense flow for either showers or eyewashes. Flow switches shall be full line size so as not to restrict water flow in order to detect flow. Provide a separate flow switch for each shower and each eyewash, where required, at each shower and eyewash station.

e. Alarms shall be activated by flow switch when emergency equipment is in operation. Audible alarm shall be intermittent signal rated at 85 Db at 10 feet. Light shall be red flashing. Alarm voltage shall be 110 vac, 60 Hz.

3. Safety Valve Lockout with Padlock:

a. Heavy duty plastic, dielectric and chemical resistant valve lock.

b. Padlock with unique serial number, hardened steel shackle, two brass keys with matching serial numbers for each padlock.

4. Anti-Freeze and Anti-Scald Valves:

a. Type: Anti-freeze valve provides freeze protection and bleeds valve to flush water through line when internal temperature drops below 35 degrees Fahrenheit and closes when the line temperature reaches

45 degrees Fahrenheit. Anti-scald valve provides scald protection and bleeds valve whenever internal temperature rises above 100 degrees Fahrenheit and closes when line temperature drops to 85 degreesFahrenheit.

G. Emergency Shower and Eyewash Station Tempering Valves:

1. The Emergency Shower Tempering Valve shall employ two fully independent control mechanisms which split the flow in half, blend each half to the design temperature, and then integrate each stream at the outlet. The valve shall control outlet temperature over a wide range of flow and shall be suitable for deluge shower or eyewash applications. The valve shall include three thermometers to measure the temperature of each stream and the merged flow. Temperature adjustment shall be vandal resistant.
2. Each independent control mechanism shall employ a liquid filled thermostatic motor to drive the valve without additional power a stainless steel sliding piston control device with reverse seat closure and both fixed and variable cold water bypass.
3. In the event of interruption of the cold water supply, each control mechanism closes off the hot water port, stopping all flow.
4. In the event of interruption of the hot water supply, each control mechanism shall allow cold flow through both the fixed and variable by pass.
5. In the event that one liquid motor fails, the control mechanism closes off the hot water port with the reverse sat and fully opens the internal variable bypass to allow cold water flow. The other control mechanism will be unaffected by the failure and will maintain design temperature.
6. Maximum Inlet Pressure: 125 psig.
7. Maximum Inlet Temperature: 180 degrees Fahrenheit.
8. Recommended Inlet Temperature: 140 degrees Fahrenheit.
9. Connections: 1¼-in. NPT.
10. Capacity: 60 gpm at 30 psig.
11. Temperature Range: 70 degrees to 100 degrees Fahrenheit.
12. Set Point: 80 degrees Fahrenheit.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. All plumbing fixtures, water coolers, and other related materials shall be inspected for chips, cracks, dents, and other flaws. Only items free from defects shall be installed in the Work. All fixtures shall be furnished with all necessary supports, hangers, brackets, etc., for the proper installation of the fixtures. Such supports, etc., shall be in accordance with the manufacturer's recommendations.

2. No fixture will be accepted that shows cracks, blisters, thin spots, or other flaws.

B. Contractor shall install all Work in complete accordance with the manufacturer's instructions and recommendations and the approved Shop Drawings.

1. Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer. Only minor repair work will be permitted in the field. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

C. Interface with Other Products:

1. Review millwork Shop Drawings.

2. Confirm the location and size of fixtures and openings before rough-in and installation.

3.02 INSTALLATION

A. Install plumbing fixtures as shown on the Contract Drawings. The Contract Drawings are generally diagrammatic, and installation of the plumbing fixtures in the allotted spaces shall be verified.

B. General Installation Requirements:

1. Install fixtures in complete accordance with the manufacturer's printed instructions and the approved Shop Drawings.

2. Fixtures requiring hot and cold water shall have the cold water faucet on the right hand side of the fixture and the hot water faucet on the left hand side of the fixture. Each fixture shall have shut off valves or stops for hot and cold water.

3. Each fixture shall be separately trapped.

4. Pipe openings shall be closed with caps or plugs during installation. Fixtures shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury.

5. Plated or polished fittings, pipes, and appliances shall be coated with protective material immediately after installation.

6. Where space limitations prohibit fixture connections with standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gas-tight and water-tight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.
7. Confirm location, size of fixtures, and openings before installation.
8. Layout fixtures as indicated on the drawings.
9. Carefully install fixtures in accordance with manufacturer's data with sufficient clearances to coordinate with accessories, specialties, and equipment specified in other divisions of these specifications and/or as shown on the drawings.
10. Hangers and carriers shall be installed in accordance with manufacturer's recommendations and in accordance with good practice and workmanship.
11. Provide one support for each water closet with all necessary hardware and gaskets, suitable for specified floor construction.
12. Upon completion of the Work, all labels shall be removed, fixtures and trim shall be cleaned of all dirt, grease, and markings, and all valves shall be properly adjusted.
13. Clean all exposed metal surfaces from grease, dirt, paint, or other foreign material.
14. Fixtures shall be properly protected from damage during construction and shall be cleaned in accordance with manufacturer's instructions.
15. Fixtures, chrome-plated piping, fittings, and trim shall be polished before requesting acceptance of the system.
16. All exposed valves and trim shall be chrome plated.
17. The entire plumbing installation shall be in accordance with best standard practices and in conformance with the plumbing ordinances in the Building Code of the City of New York.
18. Coordinate shower valve assembly installation with installation of shower stall, shower partitions, and base.
19. Lavatory faucets for handicapped and non-handicapped utilization shall match.
20. Insulate drain, trap, hot, and cold water supply lines under handicapped lavatories.

C. Fixture Heights:

1. The Contractor shall install fixtures to the heights above finished floor as specified, herein below. Installation of fixtures for use by the physically handicapped shall be in accordance with ANSI/CABO A117.1.

   a. Emergency Eyewash and drench hose:

      1) Emergency eyewash 38 in. to receptor rim.

D. Fixture Rough-In:

1. The following table, Table 22 10 00-1, Fixture Rough-In Schedule, indicates the minimum size of run out piping that shall be provided to the fixtures.

TABLE 22 10 00-1
FIXTURE ROUGH-IN SCHEDULE

Fixtures	Hot Water	Cold Water	Waste	Vent
Service Sink	½-in.	½-in.	3-in.	2-in.

3.03 FIELD TESTING / QUALITY CONTROL

A. Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

B. Support Testing:

1. For this field test, all wall hung fixtures shall have a sand bag load placed on the fixture, with sand bag weight in accordance with the Table 22 40 00-2, Testing Schedule, below:

TABLE 22 10 00-2
TESTING SCHEDULE

Fixture	Load
Mop Sink Faucet	50 lbs

1. Wall hung fixtures shall not exhibit any downward deflection during support testing.

3.04 STARTUP / DEMONSTRATION

A. Disinfection:

1. Prior to placing the potable water systems in service, they shall be disinfected in accordance with AWWA Standard C601, Section 33 01 10.60, Disinfection, and any additional requirements prescribed by the public health authorities having jurisdiction.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all fixtures for their intended uses.
2. The Contractor shall operate each fixture to ensure its performance without splashing, noise, or overflow.

B. Cleaning:

1. The Contractor shall thoroughly clean all surfaces of the installed fixtures and polish all chromed surfaces.
2. Clean work as specified in the Contract Documents.

C. Protection of Finished Work:

1. Protect finished Work as specified in Contract Documents.
2. Fixture Use: Do not permit use of fixtures.

END OF SECTION

SECTION 22 13 29 16 - SUBMERSIBLE SEWAGE PUMPS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all submersible sewage pumps, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

C. All submersible sewage pumps shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

B. Section 10 14 01 – Identifying Devices

C. Section 26 05 91 – Low-Voltage Electric Motors

D. Section 40 05 96 – Vibration and Seismic Controls

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	UL	Underwriters Laboratories
2.	ASTM	American Society for Testing Materials

B. Reference Standards:

1.	UL Listed	
2.	ASTM A536	Ductile Iron Castings
3.	ASTM A518	Corrosion-Resistant High-Silicon Iron Castings

1.05 DESCRIPTION

A. This Section includes requirements for providing submersible sewage pumps and accessories in accordance with applicable standards and regulations. In addition:

1. Submersible sewage pumps shall be furnished completely with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances
    a. Building Code of the City of New York.
    b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. All components of the submersible sewage pumps shall be provided by the Contractor through a single Plumbing vendor.
    a. The Contractor shall have the sole responsibility of matching all components and providing equipment which functions together as a system.
2. The submersible sewage pumps shall be standard equipment of the manufacturer.

3. The submersible sewage pumps shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.

4. All submersible sewage pumps shall be selected from performance data and not from rating tables.

5. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

b. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

c. Pump performance indicating the operating point.

d. Details of corrosion resistance coating.

e. Weights of assembled units.

f. Motor nameplate data as specified in Section 26 05 91 - Low-Voltage Electric Motors.

g. Detailed specifications and data sheets for all accessories.

h. Example equipment nameplate data sheet.

i. Schematic diagrams for electric and control systems showing wiring for individual equipment items and interconnecting wiring diagrams.

j. Shop and field testing procedures.

k. Deviations from the Contract Documents.

l. Wiring diagrams with numbered terminal blocks for all external connections.

m. Description of control system.

n. Motor Tests and Data: For each motor submit a certified motor test data sheet or a certified motor data sheet from an electrically duplicate motor, in accordance with Section 26 05 91 - Low-Voltage Electric Motors.

o. List of recommended lubricants.

p. Operation and maintenance manuals

2. Information Submittals:

a. Spare Parts List

b. Special Tools List

c. Reports of Certified Shop Tests

d. List of Lubricants:

1) The manufacturer shall submit a list with a minimum of four (4) manufacturers' standard lubricants which may be used interchangeably for each type of lubricant required.

a) The Contractor shall utilize this list in preparing his comprehensive lubrication survey as described in the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the submersible sewage pumps for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The submersible sewage pumps shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The submersible sewage pumps shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

1. Provide the following spare parts for up to every four (4) of the same size, model, and type of submersible sewage pumps furnished under this Section:

2. Provide electric motor spare parts in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All equipment provided under this Section shall be covered by a two (2) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Submersible Sewage Sump Pump:

1. ITT Gould Pump Distributor, Seneca NY;
2. Zoeller Pump Company Louisville, KY
3. Hydromatic Pumps Inc. Ashland, OH
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Submersible Sump Pump:

1. UL listed, factory assembled and tested submersible type pumps for operation under water up to maximum 120 degrees F or higher and capable of passing minimum 1/2-inch spherical solids. Pump shall be complete with cast-iron casing with corrosion resistant finish, cast iron or bronze impeller, stainless steel shaft, carbon/ceramic mechanical seals, sealed heavy-duty ball bearings, water-cooled hermetically-sealed motor, built-in automatic reset thermal protection, stainless steel lift handle, and waterproof three-conductor cables and grounded plugs. Pumps shall have single seal design.
2. Provide adjustable/variable level float switch complete with waterproof three-conductor cable and grounded plug. Plug shall be designed for piggybacking into pump grounded plug. Float shall have plastic encased variable level switch designed for use in minimum 18 inch diameter sump. Variable level control switch shall be normally open when hanging down vertically above sump liquid level, and close when it reaches a few degrees above the horizontal position.
3. Provide UL listed alarm panel complete with high water alarm light, high water alarm horn with alarm test and horn silence switch, 115 VAC auxiliary dry high level alarm contacts, and NEMA 4X thermoplastic enclosure. Alarm panel shall operate on 115 VAC circuit separate from pump.
4. Select the pump so that the operating point is in the middle one half of the characteristic performance curve for the pump to be furnished.
5. Submersible sewage pumps shall be as shown on the Contract Drawings.

a. The capacity of all submersible sewage pumps shall be as shown on the Contract Drawings.

6. Each sump pump shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

7. Motors:

   a. Motors shall comply with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

   b. Unless otherwise indicated, motors shall be of the totally enclosed.

   c. Motors shall not be selected for operation in the service factor range/zone. The maximum brake horsepower required at any point on the performance curve shall not exceed the rated horsepower of the motor.

   d. Motor horsepower shall be 1/3

   e. Motors shall have thermal protection.

8. Electrical Service:

   a. Motors ≤ 1/3 hp: 115V, single phase, 60 Hz.

   b. Motor shall have a running amp of 10.

9. Material:

   a. Base material shall be thermoplastic.

   b. Housing material shall be cast iron.

   c. Impeller material shall be plastic.

   d. Mechanical seal material shall be Silicon Carbide.

10. Float:

    a. Submersible sewage pumps shall have a vertical float type.

11. Disconnect Switches: all sump pumps shall have their own disconnect switch.

12. Vibration isolators:

    a. All vibration isolators shall be provided in conformance with the requirements of Section 40 05 96 - Vibration and Seismic Controls.

    b. Isolators shall have a minimum efficiency of 90 percent.

    c. Installation, type, number, and size of vibration isolators shall be in conformance with the manufacturer's recommendations for the frequencies involved.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Identification:

1. Provide in accordance with Section 10 14 01 - Identifying Devices.
2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.
3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit, shall give the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

B. Coatings:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 - Painting.
2. Coating shall be applied in the shop using the manufacturer's approved system.
3. Motors shall be painted in accordance with either Section 26 05 91 – Low-Voltage Electric Motors.
4. Coat machined, polished, and non-ferrous metal surfaces and similar un-painted surfaces with corrosion prevention compound, which shall be maintained during storage and until equipment begins operation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All submersible sewage pumps shall be as efficient as those submersible sewage pumps that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.
2. The licensed Professional Engineer shall sign and seal all shop test reports.
    a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.
2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by the Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install submersible sewage pumps in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

3. Motor tests shall be performed in accordance with Section 26 05 91 - Low-Voltage Electric Motors.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the submersible sewage pumps in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.

2. The Contractor shall include instruction on care and maintenance of the submersible sewage pumps in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the Site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all submersible sewage pumps for their intended uses.

B. Protection:

1. The submersible sewage pumps shall be protected as per the requirements of the Contract Documents. The use of submersible sewage pumps shall not be permitted until permission is given by the Engineer.

    a. When permission is given, the Contractor shall operate each submersible sewage pump to ensure its performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed submersible sewage pumps and remove all debris and waste materials resulting from installation.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all plumbing fixtures, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	13
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	13
3.01	Examination / Preparation	13
3.02	Installation	14
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	17
3.05	Adjusting / Protection / Cleanup	17

C. Plumbing fixtures shall be as indicated in the Plumbing Fixture Schedule as shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 33 01 10.60 – Disinfection of Piping

B. Section 26 29 13 – Enclosed Controllers

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	ARI	American Refrigerating and Air
2.	CABO	Council of American Building Officials
3.	GPF	Gallons per Flush
4.	USCS	U.S. Department of Commerce Commercial Standard

B. Reference Standards:

1.	ASME A112.6.1M	Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2.	ASME A112.18.1M	Plumbing Fixture Fittings.
3.	ASME A112.19.1M	Enameled Cast Iron Plumbing Fixtures.
4.	ASME A112.19.2M	Vitreous China Plumbing Fixtures.
5.	ANSI A112.19.5	Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).
6.	ANSI Z358.1	Emergency Eyewash and Shower Equipment.
7.	ANSI/ARI 1010	Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.
8.	ANSI/CABO A117.1	Accessible and Usable Buildings and Facilities.
9.	U.S. Department of Commerce Commercial Standard.	
10.	New York City Building Code.	

1.05 DESCRIPTION

A. This Section includes requirements for providing plumbing fixtures in accordance with applicable standards and regulations. In addition:

1. Plumbing fixtures shall be furnished completely with all accessories, attachments, fastenings, and other appurtenances as specified and/or as may be required for a satisfactory installation.
2. Plumbing fixtures shall be of the water conservation type and shall conform to the requirements of the New York City Building Code.
3. Plumbing fixtures for use by the physically handicapped shall be in accordance with ANSI/CABO A117.1.

B. All plumbing fixtures are to be of white vitreous china, unless otherwise specifically noted. Where enameled iron fixtures are specified, they shall be furnished with acid-resisting enamel.

1.06 QUALITY ASSURANCE

A. The Work shall be performed by a New York City licensed plumber.

B. All proposed plumbing fixtures and fittings shall be of a single manufacturer and of similar character in any room or location; escutcheons, handles, etc., on the different fixtures shall be of the same design.

C. All plumbing fixtures shall be "First Quality" as defined and set forth in Commercial Standard CS77-28 as promulgated by the U.S. Department of Commerce.

D. Plumbing fixtures shall be as efficient as those fixtures that have been tested to perform satisfactorily for at least two (2) years.

E. All wall-hung fixtures shall be adequately supported from the floor with fixture support carriers. Floor mounted fixtures shall be installed as per manufacturer instructions.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Provide catalogue cuts of all plumbing fixtures, showing: sizes, rough-in dimensions, utility sizes, faucets, drains, carriers, flush valves, trim and finishes, and any electrical requirements.

b. Complete assembly, layout required clearances, and installation drawings; all with clearly marked dimensions.

c. Provide a list of manufacturer's recommended special tools and spare parts to be supplied.

d. Operation and Maintenance Manuals: Submit operation and maintenance manuals for plumbing fixtures, faucets, drains, mixing valves, flush valves, carriers, assembly of parts list for flush valves, signage, emergency equipment and electric water coolers as required in accordance with the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation and packing of the plumbing fixture for shipment shall be in accordance with the manufacturer's commercial practice subject to the approval of the Engineer.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Plumbing fixtures shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.
2. Plumbing fixtures shall be protected from corrosion and deterioration, and plumbing fixtures shall be stored in a dry area.
    a. Plumbing fixtures stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.
3. Plumbing fixture interiors shall be kept free from dirt and foreign matter.
4. Plumbing fixtures shall be properly protected from damage during construction and shall be cleaned in accordance with manufacturer's instructions prior to installation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the products provided under this Section, and as per the requirements of the Contract Documents. In addition:
    1. Furnish the following spare parts:
        a. One (1) set of faucet washers per three (3) faucets.
        b. One (1) flush valve service kit per three (3) flush valves.

B. Tools: Provide standard and special tools as well as supplies necessary to service, disassemble, repair, and adjust the products.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Water Closets (Items Nos. WC-1):
    1. American Standard Co., Piscataway, NJ;
    2. Kohler Co., Kohler, WI;
    3. Sloan Valve Co., Franklin Park, IL;
    4. Or approved equal.

B. Handicapped Lavatories (Items Nos. HCL-1):
    1. American Standard Co., Piscataway, NJ;
    2. Kohler Co., Kohler, WI;

3. Sloan Valve Co., Franklin Park, IL;
4. Or approved equal.

C. Service Sinks (Item No. SS-1):
1. Kohler Company, Kohler, WI;
2. Watts Water Technologies, Inc., North Andover, MA;
3. Or approved equal.

D. Electric Water Coolers (Items Nos. EWC-1, EWC-2):
1. Elkay Manufacturing Co., Oak Brook, IL;
2. Haws Co., Lane Sparks, NV;
3. Halsey Taylor, Oak Brook, IL;
4. Or approved equal.

E. Emergency Eyewash and Showers:
1. Emergency Eyewash and Drench Hose (Corrosion Resistant): ESD-1:
   a. Model No. 8905, as manufactured by Haws Drinking Co., Lane Sparks, NV,;
   b. Model No. SE-925 as manufactured by Speakman Co., New Castle, DE,;
   c. Model No. G5026 as manufactured by Guardian Equipment Co., Chicago, IL.
   d. Or approved equal.
2. Flow Switches, Audible and Visible Alarms:
   a. Haws Drinking Co., Lane Sparks, NV;
   b. Speakman Co., New Castle, DE;
   c. Or approved equal.

F. Emergency Shower and Eyewash Station Tempering Valves:
1. Model 911 as manufactured by Lawler Manufacturing Co., Edison, NJ;
2. Model TM-800 as manufactured by Leonard Valve Co., Cranston, RI;
3. Or approved equal.

G. Mop Sinks (Item No. MS-1):
1. Mop Sink:
   a. American Standard Co., Piscataway, NJ;
   b. Or approved equal.
2. Corner Mop Receptor:

a. Model 97 as manufactured by Florestone Products Co., Inc. Madera, CA;

b. Or approved equal.

3. Faucet:

a. Model No. 8344.111 as manufactured by American Standard Co., Piscataway, NJ;

b. Or approved equal.

H. Mop Receptor (MR):

1. Model No. Fiat MSB-3624, as manufactured by American Standard Co., Piscataway, NJ;

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. All fixtures shall be white.

B. All plumbing fixtures shall be of high quality and shall be manufactured from the following materials:

1. Vitreous china shall be non-absorbent, hard-burned, and vitrified throughout the body.

2. Porcelain-enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces.

3. Internal parts of flush and/or flushometer valves, shower mixing valves, shower heads, face plates, and pop-up stoppers of lavatory waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS), or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than two (2) years.

a. Plastic in contact with hot water shall be suitable for 180 degrees Fahrenheit (82.0 degrees Celsius) water temperature.

C. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.

1. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap.

2. Faucets shall have chrome plated flexible tube risers with loose key-operated shutoff valves.

3. All exposed traps shall be cast brass swivel chromium plated, grounded joint, and with cleanout.

4. Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view.

D. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports.

E. Water Closets:

1. Item No. WC-1:

a. Type: Wall-hung, direct-fed siphon jet.

b. Features:

1) Water saver (or equivalent) dual flush water closet where one third of the sum of the high flush volume plus twice the low flush volume is less than or equal to 1.28 GPF.

$$\frac{\text{High Flush Volume} + \left(2 \times \text{Low Flush Volume}\right)}{3} \leq 1.28\,\text{GPF}$$

2) Elongated bowl. Top spud flushometer mounting.

c. Materials: Vitreous China, white.

d. Accessories:

1) Conventional dual flush valve, high efficiency (1.1 / 1.6 GPF) shall be equal to SLOAN, Polished Chrome Finish, Dual Flush, Exposed Water Closet Flushometer

2) Electronic dual flush valve, (1.1 / 1.6 GPF) shall be equal to SLOAN Exposed Hardwire, Sensor Activated SLOAN ECOS Hardwire Dual Flush Water Closet Flushometer with Smart Sense Technology.

3) Battery operated dual flush valve (1.1 / 1.6 GPF) shall be equal to SLOAN Water Conserving Dual Flush Electronic Flushometer with "Low Battery" flashing LED with sensor control circuit, solenoid valve, transformer, connection boxes, etc.

4) Seat, shall be equal to Kohler white open front with molded wood material.

5) Closet support, adjustable carrier shall be equal to Jay R Smith Wall-Hung Siphon Jet Water Closet Support with Double adjustable rough-in support for single-pour flood construction

6) Or approved equal.

2. Item No. WC-2:

a. Same as specified for WC-1, hereinabove, except furnish a Jay R. Smith "High Set" closet support carrier as required.

F. Handicapped Lavatories:

1. Item No. HCL-1:

a. Type: Wall hung wheelchair lavatory.

b. Materials: Vitreous China, white.

c. Features:

1) Anti-splash rim.

2) Front overflow.

3) Concealed arm support.

d. Accessories:

1) Conventional Faucet, faucet, commercial self-closing double pedal valve shall be equal to American Standard Double Pedal Valve with polished chrome finish, wall mounted with extended color coded pedals, red (hot) and blue (cold)

2) Electronic faucet shall be equal to Delany Lavatory Faucet activated by infrared sensor powered by a 9V external wall plug-in transformer and 0.5 GMP aerator .

3) Concealed arm carrier, floor mounted shall be equal to Jay R Smith, Lavatory and Sink Support for High Back Lavatories – Floor Mounted.

4) Trap, "P-trap" with cleanout, slip joint inlet, 17 gauge tubing, 1¼-in. by 1½-in. outlet, chrome finish shall be equal to Kohler Polished Chrome.

5) Hot and cold water supplies and drain piping shall be provided with insulation guard in accordance with ANSI requirements.

6) Furnish insulation guard for hot and cold supplies and drain piping in accordance with ANSI requirements.

G. Electric Water Coolers:

1. Electric water coolers shall be nominal 120 volts, 1 phase, 60 Hertz electrical service, in accordance with Section 26 29 13 - Enclosed Controllers.

2. Item No. EWC-1:

a. Water cooler shall deliver a minimum capacity of 8 gph of 50 degrees Fahrenheit water temperature supply based on 80 degrees Fahrenheit inlet water and 90 degrees Fahrenheit ambient air temperature.

b. Easy touch push bars.

c. Water bottle filling station with sanitary no touch electronic sensor activation with automatic 20 second shut-off timer.

d. Fountain top shall be stainless steel.

e. Cabinet finish shall be stainless steel.

3. Item No. EWC-2:

a. Water cooler shall be dual height drinking fountain with sculptured bowl.

b. Receptors, back plate and grille plate shall be manufactured of heavy gauge stainless steel with a No. 4 satin finish.

c. Bubbler shall be one-piece chrome plated, shielded anti-squirt angle stream designed to prevent contamination.

d. Minimum capacity of unit shall be eight gallons per hour of 50 degrees Fahrenheit water temperature supply based on 80 degrees Fahrenheit inlet water and 90 degrees Fahrenheit ambient air temperature.

e. Water bottle filling station with sanitary no touch electronic sensor activation with automatic 20 second shut-off timer.

H. Emergency Eyewash and Showers:

1. Emergency Eyewash and Drench Hose (Corrosion Resistant): ESD-1:

a. Type: Wall mounted corrosion resistant emergency eyewash station with drench hose.

b. Materials:

1) Eye/Face-Wash:

a) Twin Buna-N covered ABS heads.

b) Stainless steel ball valve, stay open type.

2) Drench Hose:

a) Minimum 8 ft. flexible reinforced PVC hose.

3) Pipe:

a) All PVC parts shall be Schedule 80.

b) Painted green with bright yellow marking.

4) Supply: 1¼-in. PVC.

c. Anchor water supply to construction.

d. Eyewash and drench hose must conform to ANSI Z358-1-1998 standards.

2. Flow Switches, Audible and Visible Alarms:

a. Type:

1) Single pole double throw.

2) NEMA 4X.

3) UL listed paddle type flow switch.

4) Contacts to be rated for five amps at 120 vac.

b. Emergency flow switch equipment shall be nominal 120 vac, 1 phase, 60 Hz electrical service, in accordance with Section 26 29 13 - Enclosed Controllers.

c. Flow switches shall only be furnished by emergency shower and eyewash manufacturer for each shower and/or eyewash station to ensure compatibility of flow switch operating in conjunction with shower or eyewash operation, or operation of both units. If flow switch is not furnished by shower and eyewash manufacturer, the Contractor shall assume complete responsibility for the proper operation of the flow sensing of the eyewash and shower units which shall include all additional conduits, wires and appurtenances; operation of flow switches shall be as stated below.

d. Flow switches shall sense flow for either showers or eyewashes. Flow switches shall be full line size so as not restrict water flow in order to detect flow. Provide a separate flow switch for each shower and each eyewash, if required, at each shower and eyewash station.

e. Alarms shall be activated by flow switch when emergency equipment is in operation. Audible alarm shall be intermittent signal rated at 85 decibels at 10 fee. Light shall be red flashing. Alarm voltage shall be 110 vac, 60 Hz.

3. Safety Valve Lockout with Padlock:

a. Heavy duty plastic, dielectric and chemical resistant valve lock.

b. Padlock with unique serial number, hardened steel shackle, two brass keys with matching serial numbers for each padlock.

4. Anti-Freeze and Anti-Scald Valves:

a. Type: Anti-freeze valve provides freeze protection and bleeds valve to flush water through line when internal temperature drops below 35 degrees Fahrenheit and closes when the line temperature reaches 45 degrees Fahrenheit. Anti-scald valve provides scald protection and bleeds valve whenever internal temperature rises above 100 degrees Fahrenheit and closes when line temperature drops to 85 degrees Fahrenheit.

I. Emergency Shower and Eyewash Station Tempering Valves:

1. The Emergency Shower Tempering Valve shall employ two fully independent control mechanisms which split the flow in half, blend each half to the design temperature, and then integrate each stream at the outlet. The valve shall control outlet temperature over a wide range of flow and shall be suitable for deluge shower or eyewash applications. The valve shall include three thermometers to measure the temperature of each stream and the merged flow. Temperature adjustment shall be vandal resistant.
2. Each independent control mechanism shall employ a liquid-filled thermostatic motor to drive the valve without additional power, a stainless steel sliding piston control device with reverse seat closure, and both fixed and variable cold water bypass.
3. In the event of interruption of the cold water supply, each control mechanism closes off the hot water port, stopping all flow.
4. In the event of interruption of the hot water supply, each control mechanism shall allow cold flow through both the fixed and variable bypass.
5. In the event that one liquid motor fails, the control mechanism closes off the hot water port with the reverse sat and fully opens the internal variable bypass to allow cold water flow. The other control mechanism will be unaffected by the failure and will maintain design temperature.
6. Maximum Inlet Pressure: 125 psig.
7. Maximum Inlet Temperature: 180 degrees Fahrenheit.
8. Recommended Inlet Temperature: 140 degrees Fahrenheit.
9. Connections: 1¼-in. NPT.
10. Capacity: 60 gpm at 30 psig.
11. Temperature Range: 70 degrees to 100 degrees Fahrenheit.
12. Set Point: 80 degrees Fahrenheit.

J. Mop Sinks:

1. Item No. MS-1:
    a. Mop sink shall be cast terrazzo manufactured tan and white marble chips cast in white Portland Cement to produce a compressive strength of 3,000 psig.
    b. Terrazzo surface shall be ground and polished with all air holes and/or pits to be grouted and excess removed and sealed to resist stains and moisture.
    c. Cement shall be reinforced with 16 ga. galvanized wire.
    d. Shoulder shall not be less than nine-in. high inside and not less than 2½-in. wide.

e. Drain body shall be brass, cast integral and shall provide for caulked lead connection not less than 1-in. deep for a 3-in. pipe.

f. Furnish with a stainless steel removable strainer plate and

g. exposed wall mounted faucet by

h. Faucet shall have two handle body with lever handles, Unions spout with pail hook and wall brace, ¾-in. hose connection and integral vacuum breaker.

K. Mop Receptor (MR): Provide floor mounted basins, 36-in. by 24-in. by 10-in., made of molded stone in No. 321 white drift.

1. Faucet: Provide a built-in valve on eight-in. centers with rigid spout with pail hook.

a. Wall brace.

b. Cross handles.

c. ¾-in. hose thread outlet vacuum breaker for back-siphonage protection.

d. Provide faucet equal to Model No. 782-E27, as manufactured by Chicago Faucet Co., Des Plaines, IL.

2. Hose and Hose Bracket:

a. 30-in. long flexible, heavy-duty ⅝-in. diameter rubber hose.

b. Cloth reinforced.

c. ¾-in. coupling at one end.

d. 5-in. long by 3-in. wide bracket of 18-gauge No. 302 stainless steel.

e. No. 4 finish.

f. Rubber grip.

g. Provide hose brackets equal to Crane® brand Model No. 832-AA by American Standard Co., Piscataway, NJ

3. Mop Hanger:

a. 2 foot long by 3-in. wide.

b. 18-ga.

c. No 302 stainless steel bracket.

d. No. 4 finish.

e. Three rubber tool grips.

f. Provide mop hanger equal to Crane® brand Model No. 899-CC by American Standard Co., Piscataway, NJ

4. Drain Body:

a. Factory installed.

b. Stainless steel.

c. Neoprene gasket.

d. Stainless steel lock ring.

e. Stainless steel combination dome strainer and lint basket attached with stainless steel screws.

f. Design the drain body outlet for a lead caulked joint to a 3-in. drain pipe.

g. Seal basin watertight at wall and floor lines with silicone sealant.

h. Provide drain body equal to Crane® brand Model No. 874 by American Standard Co., Piscataway, NJ.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. All plumbing fixtures, water coolers, and other related materials shall be inspected for chips, cracks, dents, and other flaws. Only items free from defects shall be installed in the Work. All fixtures shall be furnished with all necessary supports, hangers, brackets, etc., for the proper installation of the fixtures. Such supports, etc., shall be in accordance with the manufacturer's recommendations.

2. No fixture will be accepted that shows cracks, blisters, thin spots, or other flaws.

B. Contractor shall install all Work in complete accordance with the manufacturer's instructions and recommendations, and the approved Shop Drawings.

1. Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer. Only minor repair work will be permitted in the field. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

C. Interface with Other Products:

1. Review millwork shop drawings.

2. Confirm the location and size of fixtures and openings before rough-in and installation.

3.02 INSTALLATION

A. Install plumbing fixtures as shown on the Contract Drawings. The Contract Drawings are generally diagrammatic and installation of the plumbing fixtures in the allotted spaces shall be verified.

B. General Installation Requirements:

1. Install fixtures in complete accordance with the manufacturer's printed instructions and the approved Shop Drawings.

2. Fixtures requiring hot and cold water shall have the cold water faucet on the right hand side of the fixture and the hot water faucet on the left hand side of the fixture. Each fixture shall have shut off valves or stops for hot and cold water.

3. Each fixture shall be separately trapped.

4. Pipe openings shall be closed with caps or plugs during installation. Fixtures shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury.

5. Plated or polished fittings, pipes, and appliances shall be coated with protective material immediately after installation.

6. Where space limitations prohibit fixture connections with standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gas-tight and water-tight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

7. Confirm location, size of fixtures and openings before installation.

8. Layout fixtures as indicated on the Contract Drawings.

9. Carefully install fixtures in accordance with manufacturer's data with sufficient clearances to coordinate with accessories, specialties and equipment specified in other divisions of these specifications and/or as shown on the Contract Drawings.

10. Hangers and carriers shall be installed in accordance with manufacturer's recommendations and in accordance with good practice and workmanship.

11. Provide one support for each water closet with all necessary hardware and gaskets, suitable for specified floor construction.

12. Upon completion of the Work, all labels shall be removed, fixtures and trim shall be cleaned of all dirt, grease, and markings, and all valves properly adjusted.

13. Clean all exposed metal surfaces from grease, dirt, paint, or other foreign material.

14. Fixtures shall be properly protected from damage during construction and shall be cleaned in accordance with manufacturer's instructions.

15. Fixtures, chrome-plated piping, fittings, and trim shall be polished before requesting acceptance of the system.

16. All exposed valves and trim shall be chrome plated.

17. The entire plumbing installation shall be in accordance with best standard practice and in conformance with the plumbing ordinances in the Building Code of the City of New York.

18. Coordinate shower valve assembly installation with installation of shower stall, shower partitions, and base.

19. Lavatory faucets for handicapped and non-handicapped utilization shall match.

20. Insulate drain, trap, and hot and cold water supply lines under handicapped lavatories.

C. Fixture Heights:

1. The Contractor shall install fixtures to the heights above finished floor as specified, herein below. Installation of fixtures for use by the physically handicapped shall be in accordance with ANSI/CABO A117.1.

a. Water Closet:

1) Standard 15 in. to top of bowl rim.

2) Handicapped 18 in. to top of seat.

b. Urinal:

1) Standard 22 in. to top of bowl rim.

2) Handicapped 19 in. to top of bowl rim.

c. Lavatory:

1) Standard 31 in. to top of basin rim.

2) Handicapped 32 in. to top of basin rim.

d. Water Cooler Fountain:

1) Standard 42 in. to top of basin rim.

2) Handicapped 34 in. to top of spout outlet.

e. Water Closet Flush Valves:

1) Standard 11 in. minimum above bowl rim.

2) Handicapped 27 in. from finished floor.

f. Emergency Eyewash and drench hose:

1) Emergency eyewash 38 in. to receptor rim.

D. Fixture Rough-In:

1. The following table, Table 22 40 00-1, Fixture Rough-In Schedule, indicates the minimum size of run out piping that shall be provided to the fixtures.

TABLE 22 40 00-1
FIXTURE ROUGH-IN SCHEDULE

Fixtures	**Hot Water**	**Cold Water**	**Waste**	**Vent**
Water Closet, Flush Valve	--	1-in.	4-in.	2-in.
Water Closet, Tank Type	--	½-in.	4-in.	2-in.
Lavatory	½-in.	½-in.	1½-in.	1½-in.
Service Sink	½-in.	½-in.	3-in.	2-in.
Water Cooler Fountain	--	½-in.	1½-in.	1½-in.

3.03 FIELD TESTING / QUALITY CONTROL

A. Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

B. Support Testing:

1. For this field test, all wall hung fixtures shall have a sand bag load placed on the fixture, with sand bag weight in accordance with the Table 22 40 00-2, Testing Schedule, below:

TABLE 22 40 00-2
TESTING SCHEDULE

Fixture	**Load**
Water Closet	250 lbs
Lavatory	150 lbs
Mop Sink Faucet	50 lbs

Electric Water Cooler	50 lbs

1. Wall hung fixtures shall not exhibit any downward deflection during support testing.

3.04 STARTUP / DEMONSTRATION

A. Disinfection:

1. Prior to placing the potable water systems in service, they shall be disinfected in accordance with AWWA Standard C601, Section 33 01 10.60 – Disinfection of Piping, Tanks, Structures, and Equipment, and any additional requirements prescribed by the public health authorities having jurisdiction.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all fixtures for their intended uses.

2. The Contractor shall operate each fixture to ensure its performance without splashing, noise, or overflow.

B. Cleaning:

1. The Contractor shall thoroughly clean all surfaces of the installed fixtures and polish all chromed surfaces.

2. Clean Work as specified in the Contract Documents.

C. Protection of Finished Work:

1. Protect finished Work as specified in Contract Documents.

2. Fixture Use: Do not permit use of fixtures.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to perform testing, adjusting, and balancing of all Heating, Ventilation, and Air Conditioning Systems, as specified and/or required for proper operation.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Implementation	5
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 80 82 – PMCS Startup and Field Testing.

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	AABC	Associated Air Balance Council
2.	NEBB	National Environmental Balancing Bureau
3.	HVAC	Heating, Ventilating, Air Conditioning
4.	TAB	Testing, Adjusting, and Balancing

B. Reference Standards:

1.	ASHRAE	Handbook – Fundamentals.
2.	AABC-MN-1	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems (1989).
3.	NEBB-01	Procedural Standards for Testing Adjusting Balancing of Environmental Systems (1991).
4.	AABC 81266	National Standards for Field Measurements, Total System Balance, Air Distribution, Hydronics Systems, Volume One.

1.05 DESCRIPTION

A. This Section includes requirements for the testing, adjusting, and balancing for HVAC Systems. In addition:

1. HVAC equipment shall be completely installed and in continuous operation as required to accomplish the test, adjust, and balance work specified.

2. Reports shall be certified by the testing engineer that the methods used and the results achieved are as specified.

3. Should corrective measures caused by faulty installation require retesting, adjusting, and balancing, such Work shall be performed at no additional expense to DEP.

1.06 QUALITY ASSURANCE

A. Balancers Qualifications:

1. Balancer shall have certification by NEBB, AABC, or SMACNA, or demonstrate that the standards and experience required for certification are possessed, all to the satisfaction of the Engineer.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited, to:

1. Action Submittals:

a. Contractor shall submit one (1) copy of the standard procedure manual, published by the TAB organization affiliated with the Contractor, to the Engineer for his records.

b. Prior to testing all systems, the Contractor shall submit a test procedure for each and every system to undergo TAB as part of the Work.

c. Report Forms:

1) Submit specimen copies of report forms for Engineer's approval.

2) Forms shall be 8½-in. × 11-in. paper for loose leaf binding, with blanks for listing of the required test ratings and for certification of report.

3) Reports shall be on the organizations approved forms imprinted with the company's name.

4) Certified report outlining procedure used to balance the system and the types of measuring devices used.

d. Test results shall be submitted on approved forms in a typed format.

e. Submit certified copies of required test reports to the Engineer for approval.

B. Information Submittals:

1. Data Sheets:

a. Submit samples of data sheets on each item of equipment for approval.

b. Submit data sheets on each item of testing equipment required.

c. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

2. Balancer's Qualifications:

a. Submit work experience or resume of proposed biographical data on employee who will directly supervise the TAB Work.

b. Licenses held by the balancer.

c. Submit a record of at least five (5) years' experience in the testing and balancing contracting industry, engaged in HVAC work, including but not limited to:

1) Names of projects.

2) Approximate contract cost of the TAB Work.

3) Amount of area that was tested, adjusted, and balanced for each project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Instruments:

1. General:

a. Contractor shall provide all necessary instrumentation, tools, ladders, etc. to complete all air and hydronic balancing tests and adjustments.

b. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

c. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.

d. Contractor shall assume full responsibility for safe keeping of all instrumentation during the course of Work.

B. Air balance instruments:

1. Provide all velometers, anemometers, pitot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, etc. as may be required to perform all air balance tests of HVAC equipment, ducts, registers, grilles, etc.

C. Water balance instruments:

1. Provide manometers, pressure gages, and other instruments and accessories as required to balance the water system.

D. System performance measuring instruments:

1. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. General:

1. All TAB of air and hydronic systems shall be performed in compliance with the standard procedure manual published by the TAB organization affiliated with the Contractor and submitted to the Engineer for approval as specified herein. Contractor shall be solely responsible for the protection and safeguarding of his Work and shall provide every protection against accidents, injury, and damage to persons and property.
2. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day.
3. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.
4. Contractor shall install additional access panels at no extra cost to DEP, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
5. Air systems shall be tested, adjusted, and balanced with clean filters.
6. Hydronic systems shall be tested, adjusted, and balanced with clean strainers.

B. Inspection:

1. The Contractor shall conform to the requirements of this Contract Equipment Check:
    a. Verify proper overload heater sizes.
    b. Verify function of safety and operating controls.
    c. Verify proper operation of equipment.
    d. Report on inspection, observation and checking procedures.

C. Testing of Piping, Equipment, and Duct:

1. General:
    a. The Contractor shall be bound by this Section to test and adjust all systems and accessories covered under this Contract.

b. The Contractor shall also comply with the requirements of testing as outlined in the individual sections.

c. Furthermore, the Contractor shall operate and maintain these systems as per the requirements of the Contract Documents and shall leave them in good working order.

d. The Contractor shall provide all necessary equipment and labor for this Work.

2. Refrigerant piping must be tested before any piping is insulated or concealed.

a. The entire refrigerant circuit must be thoroughly tested to be sure that it is absolutely tight.

b. The system shall be tested with oil pumped, dry nitrogen.

c. The low side of the system shall be tested at 150 psig and the high side at 300 psig.

d. All pipe joints shall be tapped sharply with a rubber mallet and tested for leaks with a soap solution.

e. After all leaks have been repaired, the system shall be charged with a small quantity of refrigerant and the entire system shall be checked with a halide leak detector.

f. Once the system is found tight, it shall be allowed to stand for six hours (6 hrs) with the pressure on.

g. If any pressure drop occurs, except those due to changes in ambient temperature, the entire system shall be retested.

h. The system shall be evacuated with a vacuum pump until vacuum of 2.5 mm Hg is achieved.

i. Under no circumstances shall the compressor be used to evacuate the system.

j. After evacuation, the system shall be allowed to stand for twelve hours (12 hrs).

k. If no noticeable rise in pressure occurs, the system shall be charged.

3. All ductwork systems including air outlets shall be tested, adjusted, and balanced for within limits of the required airflows as indicated on the Contract Drawings.

4. Overall System Test:

a. After all final tests have been performed on all equipment and on all sub-systems installed under this Contract, including the testing of all controls specified in other Sections, and after the results from all such testing have been accepted, the Contractor shall test the overall

system by demonstrating its ability to respond properly to normal changes in controlled parameters, as well as to system upsets.

b. To facilitate this, the Contractor shall make available a minimum of two (2) personnel, thoroughly familiar with the systems and equipment installed under this Contract, for a minimum of seven (7) days to test the system by changing controlled parameters and generating system upsets as directed by the Engineer, and demonstrating that the sequential action appropriate to the particular change or upset occurs automatically.

c. Where actual change or upset is not feasible, the Contractor shall simulate the change or the upset.

d. Controlled parameter changes shall include, but not necessarily be limited to, any change in temperature, pressure, flow rate, fluid level, load, etc., which should result in an automatic change in the position of a control valve or control damper, in the output rate of a piece of equipment, in the normal start-up or shutdown of equipment, etc.

e. The change in the state of the controlled device or equipment shall be shown to result in a corrective action on the controlled parameter.

f. Upsets shall include, but not necessarily be limited to, any condition which should cause annunciation of an alarm, safety shutdown of equipment, startup of standby equipment, closing of fusible-link devices, lifting of relief valves, etc.

g. The Contractor shall immediately restore to its original state any safety device, the state of which has been changed by its having been tested.

5. Contractor shall immediately correct any system deficiency that should occur during testing.

6. After the overall system testing has been completed, and after all final adjustments have been made, the Contractor shall operate and maintain all new systems and equipment, site-wide, associated therewith, for a period of thirty consecutive days.

a. During this period all normal maintenance (filter replacements, strainer cleaning, periodic checks of safety devices, datalogging, etc.) shall be performed by the Contractor.

b. If, during this period, any work beyond routine maintenance of equipment and materials installed under this Contract, should be required to maintain proper operation of the overall system, the elapsed time shall be forfeited, and a new thirty-day period shall commence following the completion of the corrective action.

7. The Engineer shall determine which fuel shall be burned in the boilers during these periods. All fuel and utilities required for system operation shall be provided by the City.

D. Balancing and Adjusting:

1. In addition to any other reference to balancing and adjusting specified elsewhere in this Section, the Contractor shall be bound by this portion of the Section to balance, adjust, and leave in good working order all systems and accessories covered under this Contract.

2. The Contractor shall procure the services of an independent balancing and testing agency which specializes in the balancing and testing of heating, ventilating, and air conditioning systems to balance, test, and adjust all systems installed under this Section.

3. The Contractor shall advise the Engineer at least two weeks in advance of the date scheduled for balancing to commence; at the Engineer's discretion, the balancing shall be conducted in the Engineer's presence.

4. At least three (3) months prior to the commencement of balancing, the Contractor shall forward a detailed explanation of the balancing procedure to the Engineer for review. In general, the method shall conform to those specified by the AABC or SMACNA.

5. All piping systems shall be balanced under this Section to provide the flows indicated on the Contract Drawings.

6. Air systems shall be balanced before all hydronic and refrigerant systems.

7. Before beginning to balance the air systems, the Contractor shall check, in the presence of the Engineer, all filters and coils for cleanliness, dampers (automatic, volume, and fire) for correct position, all fans for proper rotation, and temperature controls for minimum completeness to allow for proper balancing.

   a. If any of the above or other conditions are found which would not allow for proper balancing, the Contractor shall take the necessary corrective actions, at his own expense, before balancing begins.

8. All heating, ventilating, and air conditioning systems shall be balanced by the Contractor by adjustment of dampers, fan sheaves, apparatus, and air outlets to provide the air quantities indicated on the Contract Drawings. If necessary, adjustments of air outlets shall be made to eliminate drafts.

9. Balancing for all air systems shall be accomplished in a manner to first minimize throttling losses, then fan speed shall be adjusted to meet design conditions. All air outlets and fans shall be balanced within five percent of the design capacity.

10. Fan Belt Deflection: No less than ¼-in. or more than a ½-in..

11. Finned Coils: Plate type fins shall be combed out with a fin comb for appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.

12. After the systems have been balanced, the Contractor shall submit and certify to the City a list containing the following minimum information for air outlets and equipment:

    a. Room or facility served.

    b. Size, quantity and model of air outlet or equipment.

    c. Type of air outlet or equipment.

    d. Air flow indicated on Contract Drawings.

    e. Air flow measured.

    f. GPM indicated on Contract Drawings.

    g. GPM measured.

    h. Entering and leaving water temperatures.

    i. Fan cfm indicated on the Contract Drawings.

    j. Fan cfm measured.

    k. Fan motor running amps.

13. The Contractor shall advise the Engineer two days in advance of the start-up of the heating and cooling water circulating systems. To be ready for start-up, the boilers, chillers, condensers, and pumps and related equipment must be "off", and the system must be filled, purged, balanced, and cooled.

14. The Contractor shall record the following:

    a. Pressure at system fill valve.

    b. Pressure at pumps (inlet or outlet).

    c. Pressure at building piping entries.

    d. System temperature.

15. The Contractor shall start heating and/or cooling equipment. Once system design temperature has been reached, and system is in equilibrium, again record the pressures listed above, as well as the temperatures at the inlets and outlets of the boilers, chillers, condensers, coils, and heat exchangers.

16. The Contractor shall submit all recorded data to Engineer for review.

17. The Contractor shall adjust any or all equipment which, in the City's opinion, is not set within acceptable limits of ± five percent.

E. Automatic Control Systems:

1. In cooperation with the control manufacturer's representative and as per the requirements of Section 40 80 82 - PMCS Startup and Field Testing, set and adjust automatically operated devices to achieve required sequence of operations.
2. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment by control system installer.

F. Marking Of Setting:

1. Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, and manual dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

G. Identification Of Test Ports:

1. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 23 07 13 – DUCT INSULATION
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all duct insulation complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

B. Section 40 05 97 – Identification for Process Equipment

1.04 REFERENCES

A. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.

B. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

C. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

D. ASTM C547 - Mineral Fiber Pipe Insulation.

E. ASTM C552 - Cellular Glass Thermal Insulation.

F. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

G. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

H. ASTM C647 - Properties and Tests of Mastics and Coating Finishes for Thermal Insulation.

I. ASTM C916 - Adhesives for Duct Thermal Insulation.

J. ASTM C920 - Elastomeric Joint Sealants.

K. ASTM C1126 - Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

L. ASTM E84 - Surface Burning Characteristics of Building Materials.

M. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

N. NFPA 255 - Surface Burning Characteristics of Building Materials.

1.05 DESCRIPTION

A. This Section includes requirements for providing duct insulation in accordance with applicable standards and regulations. In addition:

1. All fastenings, auxiliary equipment, accessories and appurtenances, necessary and/or required for a complete installation, shall be included within the scope of Work.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Engage a single firm with undivided responsibility for performance and other requirements and components of the duct insulation installation.

2. Engage a firm which can show successful experience in the manufacture of duct insulation systems of scope and type similar to the required Work.

B. Installer Qualifications:

1. Installer shall have at least five (5) years of experience in the installation of the Work specified. Only tradesmen with specific skills and experience in this type of Work shall be employed.

C. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction.

1. Underwriters Laboratories, Incorporated (UL).

2. National Fire Protection Association (NFPA).

3. Local and State Building Codes and Ordinances:

a. New York City Building Code

b. New York State Uniform Fire Prevention and Building Code

c. New York State Energy Conservation Construction Code

D. General: Insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84:

1. Flame spread, 25 maximum.

2. Fuel contributed, 50 maximum.

3. Smoke developed, 50 maximum.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited, to:

1. Action Submittals:

a. Samples: Submit for approval samples of the following:

1) Thermal Insulation - Flexible.

2) Thermal Insulation - Rigid.

3) Acoustical Insulation.

b. Shop Drawings: Submit for approval manufacturer's catalog literature, specifications, and illustrations with the following information:

1) Thermal properties

2) Physical properties

3) Fire hazard ratings

4) Facing information

5) Installation instructions

6) Jointing recommendations for butt joints and longitudinal seams

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Contractor shall provide spare parts and special tools necessary to service and repair duct insulation provided under this Section.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Duct insulation:

1. Owens Corning, Toledo, OH.
2. CertainTeed Corp., Valley Forge, PA.
3. Schuller International, Inc. (Johns-Manville), Littleton, CO.
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Exposed Ductwork Insulation (Rigid):

1. The following ductwork exposed in room shall be insulated:
   a. All outside air intake ducts and plenums from the outside air intake louver, outside air intake shaft, or roof-mounted intake up to the point where the duct or plenum is connected to the heating and ventilating units, air conditioning units, or supply fans in heated and air-conditioned spaces.
   b. All exhaust and return air ductwork from air-conditioned spaces.
   c. All supply and return air ductwork associated with air conditioning units.
   d. All heated and air-conditioned ductwork located in unheated spaces.
   e. All heated and air-conditioned ductwork located outdoors shall be insulated and covered with weatherproof stainless steel jacket.
   f. Where indicated on the Contract Drawings.

2. All exposed ductwork insulation shall be minimum 1½-in. thick (except 2-in. thick for ducts located outdoor and outside air intake plenums) glass fiber board having a density of not less than 3.0 lbs./ft^3, and a thermal conductivity of not more than 0.23 BTU·in./($h·ft^2·°F$) at 75° Fahrenheit mean temperature.

3. The exposed ductwork insulation shall be impaled over pins welded to the duct surface on 12-in. centers.

    a. The pins shall be coated with vapor barrier adhesive, and the insulation shall then be secured with caps over the pins.

4. All joints and breaks in the vapor barrier shall be sealed with 3-in. wide strips of the vapor barrier facing.

5. All insulation shall be reinforced with corner bead.

6. The facing shall be finished with a 3-ply application of lagging adhesive, glass fabric reinforcing and a finish coat of mastic.

B. Concealed Ductwork Insulation (Flexible):

1. The following ductwork located above hung ceiling shall be insulated:

    a. All supply, exhaust, and return ductwork associated with air conditioning units.

    b. All outside air intake ducts and plenums from the outside air intake louver, outside air intake shaft or roof mounted intake up to the point where the duct or plenum is connected to the heating and ventilating units and supply fans.

    c. Where indicated on the Contract Drawings.

2. All concealed ductwork insulation shall be 1½ in. thick flexible fiberglass, having a thermal conductivity of not more than 0.28 BTU·in./($hr·ft^2·°F$) at 75° Fahrenheit mean temperature.

3. The insulation shall have a reinforced foil vapor barrier facing.

4. Insulation shall be secured with 4-in. wide bands of adhesive on 12-in. centers.

5. All joints shall be sealed by adhering a 2-in. sealing lap or 3-in. strips of vapor barrier facing applied with vapor barrier adhesive.

6. On horizontal ducts over 24-in. wide, welded pins and clips shall be used on the underside on 18-in. centers.

C. Acoustical Insulation:

1. Ductwork shall be internally insulated where indicated on the Contract Drawings.

2. Internal Duct Liner - Acoustical Insulation:

    a. Type: Fiberglass duct liner board with black surface.

b. Density: Minimum 1½ lbs. per cubic foot.

c. Thickness: 1½ in. minimum.

d. Thermal Conductivity: 0.23 Btu·in./(h·ft^2·°F) at 75°Fahrenheit mean temperature.

D. Adhesives and Accessories:

1. Acoustical Lining Insulation Adhesive:

a. Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

b. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

2. Mineral Fiber Insulation Cement:

a. Cement shall be in accordance with ASTM C195.

3. Lagging Adhesive:

a. Lagging adhesives shall be nonflammable and fire-resistant and shall have flame spread and smoke developed ratings of 25/50 when measured in accordance with ASTM E84.

4. Contact Adhesive:

a. Adhesive may be dispersed in a non-halogenated organic solvent with a low flash point (flash pint less than minus 25°Fahrenheit when tested in accordance with ASTM D3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200°Fahrenheit.

b. The adhesive shall be nonflammable and fire resistant.

5. Caulking:

a. Caulking shall be in accordance with ASTM C920.

6. Corner Angles:

a. Nominal 0.016 in. type 316 stainless steel 1-in. × 1-in. with factory applied kraft backing and adhesive.

7. Finishing Cement:

a. Mineral fiber hydraulic-setting thermal insulating cement ASTM C449.

8. Fibrous Glass Cloth and Glass Tape:

a. Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E84.

9. Staples shall be outward clinching Type 316 stainless steel.

10. White Vapor Retarder All Service Jacket (ASJ):

a. Shall be used on hot/cold pipes, ducts, or equipment.

b. Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting.

11. Weatherproof Jackets:

a. Type 316 stainless steel jackets shall be smooth sheet, 0.016 in. nominal thickness.

b. Corrugated metal jacket shall not be used outdoors for insulated ducts.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Source Quality Control: Perform the following tests and inspections at factory.

1. Flame Spread

2. Smoke Developed

3. Fuel Contributed

B. Manufacturer's Markings:

1. Stamp or label with manufacturer's name and brand every package or standard container of covering, adhesive and coating delivered to the job site for use.

2. Exposed side of insulation shall be legibly labeled by the manufacturer to show thickness, type and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Contractor shall install all Work in complete accordance with the manufacturer's instructions and recommendations, and the approved Shop Drawings.

B. All duct leaks shall be sealed prior to installation of external insulation to prevent billowing and damage to insulation.

C. Contractor shall ensure that all surfaces are clean and dry before applying insulation.

D. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of Work.

E. Contractor shall ensure that ductwork has been inspected and released for application of insulation.

F. Contractor shall not install damaged insulation until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

1. Only minor repair work will be permitted in the field.

2. All damaged insulation requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install duct insulation in complete accordance with the manufacturer's instructions and the approved Shop Drawings.

B. Install insulation to make surfaces smooth, even, and substantially flush with adjacent duct insulation.

C. Duct sizes indicated on the Contract Drawings are clear inside dimensions. Increase duct sizes to give designated inside dimensions when internal insulation is used.

D. Thickness of rigid insulation shall be greater than the seams or angles of ductwork to which it is applied.

E. Duct insulation shall be continuous through sleeves and prepared openings.

F. Insulation shall terminate at fire dampers and flexible connections.

G. Vapor barrier materials shall be applied to form a complete unbroken vapor seal over insulation.

H. Provide Type 316 stainless steel jacketing and waterproof sealants for insulated ducts exposed to outdoor.

I. Field Painting shall comply with the requirements of Section 09 91 00 - Painting.

J. Identification markers and labels shall be in conformance with the Contract Documents and Section 40 05 97 - Identification for Profess Equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all insulation in accordance with the requirements of the Contract documents. In addition:

1. Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, instruction, and all other pertinent information.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Remove all debris, waste materials, and loose foreign matter resulting from installation.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all complete and operable Fuel Oil Systems for the Standby Generator in accordance with this Section, other Contract Sections, Contract Drawings, and the codes and standards listed herein.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	16
PART 3	EXECUTION	16
3.01	Examination / Preparation	16
3.02	Implementation	16
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	20
3.05	Adjusting / Protection / Cleanup	20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s), or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 27 00 – Measurement and Payment

B. Section 01 33 00 - Submittal Procedures

C. Section 01 78 25 – Operations and Maintenance Manuals

D. Section 01 79 05 – Equipment Start-up and Training

E. Section 09 91 00 - Painting

F. Section 40 05 07 - Hangers and Supports for Process Piping

G. Section 40 61 13 - PMCS General Requirements

H. Section 40 80 82 – PMCS Startup and Field Testing

I. All Division 40 PMCS Sections

1.04 REFERENCES

A. American Petroleum Institute (API):

1. 600: Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries
2. RP 1110: Pressure Testing of Liquid Petroleum Pipelines
3. Std 599: Metal Plug Valves - Flanged, Threaded and Welding Ends

B. American Society of Mechanical Engineers (ASME):

1. B1.1: Unified Inch Screw Threads (UN & UNR Thread Form)
2. B16.3: Malleable Iron Threaded Fittings
3. B16.5: Pipe Flanges and Flanged Fittings
4. B16.9: Factory-Made Wrought Steel Buttwelding Fittings
5. B16.11: Forged Fittings, Socket-Welding and Threaded
6. B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
7. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
8. B16.39: Malleable Iron Threaded Pipe Unions
9. B18.2.1: Square and Hex Bolts and Screws Inch Series
10. B18.2.2: Square and Hex Nuts
11. B31.1: Power Piping
12. B31.3: Process Piping
13. B31.4: Piping Transportation Systems for Liquid Hydrocarbons and Other Liquid
14. B40.1: Gauges - Pressure Indicating Dial Type - Elastic Element
15. BPVC SEC IX: Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

16. BPVC SEC VIII D1: Boiler and Pressure Vessel Code; Section VIII, Rules for Construction of Pressure Vessels Division 1

C. ASTM International (ASTM):

1. A36: Carbon Structural Steel
2. A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A194: Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
4. A307: Carbon Steel Bolts and Studs, 60000 PSI (413.7 mPa) Tensile Strength
5. American Welding Society (AWS):
   a. A5.8: Filler Metals for Brazing and Braze Welding
   b. Z49.1: Safety in Welding, Cutting, and Allied Processes

D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-71: Gray Iron Swing Check Valves, Flanged and Threaded Ends
2. SP-72: Ball Valves with Flanged or Butt-Welding Ends for General Service
3. SP-80: Bronze Gate, Globe, Angle and Check Valves
4. SP-110: Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

E. National Fire Protection Association (NFPA):

1. 30: Flammable and Combustible Liquids Code
2. 31: Installation of Oil Burning Equipment
3. 70: National Electric Code
4. 780: Installation of Lightning Protection Systems
5. The Society for Protection Coatings (SSPC):
   a. Paint 20: Zinc-Rich Primers, (Type I - "Inorganic" and Type II - "Organic")
   b. SP 10: Near-White Blast Cleaning

F. Underwriters Laboratories (UL):

1. 80: Steel Tanks for Oil-Burner Fuel
2. 142: Steel Aboveground Tanks for Flammable and Combustible Liquids508A: Industrial Control Equipment
3. 674: Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
4. 698: Industrial Control Equipment for Hazardous (Classified) Locations
5. 842: Valves for Flammable Fluids

6. 886: Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
7. 2085: Protected Aboveground Tanks for Flammable and Combustible Liquids
8. Gas & Oil Dir: Flammable and Combustible Liquids and Gases Equipment Directory

G. Local Codes and Regulations:

1. NYC Fire Code
2. NYC Mechanical Code
3. NYSDEC Petroleum Bulk Storage Regulations NYCRR 613 Part 613 and 614.

1.05 DESCRIPTION

A. The Work under this Section shall include, but not be limited to, the following components: Bulk fuel storage tank, Fuel fill station with overflow protection, day tank, Fuel oil transfer pump set, above ground fuel oil supply and return piping, tank gauging, and leak detection and alarm system, including manufacturer-provided communications cable to tank level and leak sensors.

1.06 QUALITY ASSURANCE

A. Consideration shall be given only to products of manufacturers who demonstrate successful experience in the manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

B. Equipment furnished to fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.
2. Install equipment that complies with state, local, and federal codes and regulations.

D. Piping Supply and Compatibility:

1. All steel process pipes, fittings, appurtenances, and specials included in this Section shall be provided by the Contractor through a single, qualified steel process pipe manufacturer.
2. The pipe and fittings shall be designed, fabricated, and installed in accordance with the standards referenced herein.

E. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, Contractor to prepare and submit for review, detailed

structural, mechanical, and electrical drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes are at no additional compensation to the Contractor.

F. Furnish the services of a qualified representative of each of the various manufacturers as required herein.

G. The representative shall inspect the installation of equipment, field test the equipment, make any necessary adjustments, field calibrate the equipment upon completion of the installation of component, and place it in initial operation. In addition, he shall instruct the operating personnel in operations, calibration, troubleshooting and maintenance of the equipment.

H. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

1.07 SUBMITTALS

A. Submittals required under this Section include, but are not limited to, the following and shall be in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings:

   a. Schematic drawings for engine generator fuel oil systems.

2. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item.

   a. Pipe and fittings

   b. Valves and valve actuators

   c. Flexible connectors

   d. Unions

   e. Strainers and filters

   f. Protective coating systems for aboveground steel piping and steel tanks including surface preparation and coating application procedures

   g. Pipe hangers and supports

   h. Fuel oil supply pump sets and controls

   i. Fuel oil storage tank

   j. Fuel oil tank level and level switch instrumentation

   k. Tank Gauging and Leak detection system

   l. Electric cut-offs

   m. Pipe and Equipment Identification signs

   n. Name plates

3. Certification - Submit documentation certifying completion of the following items in compliance with this Section.
    a. Flushing
    b. Carrier piping tests
    c. Protective coating systems tests
    d. Fuel oil storage tank tests
    e. Leak detection test
    f. Manufacturer services
4. Operations and Maintenance Manuals - Prepare manuals in accordance with Section 01 78 25 – Operations and Maintenance Manuals. Submit a certified list of qualified service organizations for support of the equipment which includes their addresses and qualifications.
5. Training Lesson Plans – Prepare Lesson plans in accordance with Section 01 79 05 Equipment Start-up and Training and provide Qualifications of the person(s) who will perform the training.
6. Obtain required tank registration or permit/approval application forms from governing regulatory agencies. Furnish completed forms to the Engineer and within ten days after contract award for their submission to the regulatory agency.
7. Provide instructions and equipment required for calibration of the leak detection system and manufacturer's recommended calibration maintenance schedule.
8. Foundation connections details for all equipment including tanks and pump sets.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Provide the manufacturer’s recommended spare parts and any special tools required.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fuel oil system specialties and pumps shall be as manufactured by:

1. Bulk Storage Tank

a. Highland Tank

b. Or approved equal

2. Fuel Oil Pump Sets

a. Preferred Utilities Manufacturing Corp

b. Or approved equal

3. Day Tank

a. Preferred Utilities Manufacturing Corp.

b. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Material and equipment for fuel oil system service shall be UL Gas & Oil Dir listed for use in fuel oil systems where such classes of material and equipment are available as listed by this organization.

B. Where applicable all products requiring approval by the FDNY shall be so accepted.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fuel oil storage tank shall comply with the Fire Prevention Code and be UL 142 labeled. Tank shall be single-wall construction of capacity, minimum thickness, and approximate dimensions indicated on the Contract Drawings. Tank shall be furnished with an integral containment dike capable of holding 150 percent of the tank volume and rain guards to minimize the collection rainfall in the containment dike. Tank construction shall be welded carbon steel. All exposed metallic items included with the tank, and all welds, shall have surfaces prepared and coated as specified in this Section. Where indicated, each fuel oil tank shall have a manhole on top of diameter indicated. Sizes and number of fittings shall be as indicated and required. All fittings shall be female pipe thread unless otherwise indicated. All fitting openings shall be plugged prior to shipping. Vent pipes shall connect to tapping at high end of tank and shall not extend more than one inch into tank.

B. Tank shall also include the following:

1. Nylon dielectric bushings on pipe connections to steel tanks.

2. All other tank accessories as indicated on the Contract Drawings.

C. Fuel Oil Supply Pump Set:

1. Pump set shall include separate Type 316L stainless steel control panel enclosure and Type 316L stainless steel pumping equipment enclosure, factory-assembled and piped on Type 316L stainless steel supports and base. The control panel enclosure shall be mounted on supporting structural members and welded to the steel base.

2. Provide factory-fabricated semi-automatic duplex fuel oil pump sets. Units shall consist of the following items:

a. Two (2) fuel oil pumps.

b. Pumps shall be piped with a duplex suction strainer, manual shut off valve, and compound gage at each pump suction. Pump discharge piping shall include pressure gage, pressure relief valve, check valve, flow switch, and manual shut off valve for each pump terminating in a common discharge connection. Pumps shall be connected to piping via flexible connectors. Strainer shall include a differential pressure switch with three-valve manifold for clogged strainer remote alarming.

c. Pumps shall be bi-rotational positive displacement, internal gear type with cast iron housing and Buna-N self-adjusting mechanical seals. Pumps shall be suitable for both continuous and intermittent duty. Motors shall have NEMA frames and open drip-proof construction. Pump and direct connected electric motor shall be factory-mounted on extended one-piece steel base plate. Provide all metal flexible coupling between pump and drive with steel OSHA guard. At each motor location provide a lockable power disconnect switch with ratings as required.

d. Stainless steel Type 316L unit base, containment, drip pan, sump, and drain plug. Drip pan shall be sized to capture potential leaks from all factory-installed piping and components. Drip pan sump shall include a level alarm switch for local alarm indicator and remote monitoring.

e. Heated Enclosure with thermostat.

3. Fuel Supply Pump Control Panel (FS-CP).

a. Comply with the requirements of Section 40 61 13 - PMCS General Requirements and related PMCS Sections.

b. NEMA 4X, 14 gauge, UL labeled enclosure with print pocket, panel main circuit breaker, panel surge suppressor, and panel heater with thermostat.

c. Controls shall be relay based (no PLC or proprietary controllers) and shall include the following oil tight 30 mm indicator lights and control switches.

1) Control Power (white) and Sump Leak (amber) push to test indicator lights.

2) Run (red), Overload (amber) and Low Flow (amber) LED push to test indicator lights for each pump.

3) Duty 1/2/Alternate selector switch provides manual selection of the duty pump or automatic alternation after each pump stop.

4) Hand-Off-Auto (HOA) switch and Estop pushbutton for each pump.

(i) HOA switch Hand position is intended for maintenance and turns the pump on without any no flow shutdown interlock.

Remote pump start/stop control of the duty pump is not available. HOA Off position is Off.

(ii) HOA Auto position is intended for normal operation and provides a pump shutdown interlock on no flow, allows pump alternation, and allows remote pump start/stop control of the duty pump.

(iii) The Estop pushbutton or motor overload from the motor starter at the MCC will stop the pump when the HOA switch is in Hand or Auto. The overload must be cleared at the MCC.

(iv) The Reset pushbutton clears all shutdown interlocks. Overload must be cleared at the remote MCC.

d. For each pump, provide a discharge flow switch and time delay relay to shut down the supply pump if flow is not proven during pump start or when running.

e. With both pump HOA switches in Auto, if the duty pump faults due to flow not being proven or motor overload, shutdown the duty pump and start the other pump.

f. Provide relay dry contacts for contacts for Sump Leak and in Auto, Run, Overload, and Loss of Flow for each pump all pre-wired to designated 24VDC numbered terminal strip.

g. For each pump provide designated numbered terminal strip for the 120VAC pump control circuit (fused) and for the run and overload contacts from the motor starter at the remote motor control center.

h. All panel interior wiring and controls and external field wiring terminations shall be factory installed and tested.

i. Assembled control panel shall be labeled in accordance with UL 508A.

D. Factory piping shall comply with steel pipe and fittings, valves, piping accessories, and pressure gages of this Section.

E. Fuel Oil Supply and Return Piping:

1. Above Ground (Single Wall)

a. Steel Pipe and Fittings (1/2 inch and Larger)

b. Pipe: ASTM A 53, Type E or F, Grade A or B, Schedule 40, black steel.

c. Threaded and Socket-Welding Fittings: ASME B16.11, forged steel, Class 2000 minimum .

d. Threaded Fittings: ASME B16.3, black malleable iron, Class 150.

2. Pressure Gages:

a. Pressure gages shall include gages for measuring pressure, vacuum or both (compound gages).

b. Pressure gages shall be ASME B40.1, liquid filled, one percent accuracy or better, with Type 316 stainless steel bourdon tube and glass-filled polyester case.

c. Gages shall have a minimum 4-1/2 inch diameter face. Dial gradations reading in "in Hg" (vacuum) and "psi" (pressure) shall be such that the normal operating pressure of the system is within middle 1/3 of scale range.

d. Gages shall be equipped with snubber, silicone filled diaphragm seal, ball valve isolation and ball valve shutoff.

e. Pressure gauges shall include a stainless steel tag with the instrument tag number as defined on the Contract Instrumentation drawings.

3. Valves:

a. Ball Valves: MSS SP-72 for flanged or butt-welding ends and MSS SP-110 for threaded, socket-welding, solder joint, grooved and flared ends, full port design, copper alloy. Valves shall have Stainless steel stem handle, ball and hardware and PTFE seats and seals.

b. Check Valves (2 inch (5.08 cm) and Smaller): MSS SP-80, Class 125, ball check, bronze body and stainless steel ball and spring.

c. Foot Valves: Single poppet type, copper alloy construction, with lapped-in metal-to-metal seating, stem-guided flat poppets, and maximum 40 mesh corrosion-resistant metal screen. Select valve for fuel oil grade used. Valve shall be line size.

d. Pressure Relief Valves: UL 842, 5-35 psi setting range, steel or bronze body, corrosion-resistant valve seats, and positive closing to prevent leakage. Valves shall be sized to relieve full outlet flow of pumps without causing pump motor to overload or any component pressure rating to be exceeded if pump discharge is inadvertently valved off. Relief valves shall be externally mounted type.

e. Pressure Reducing Valves: Self-operated, spring-loaded; cast iron body, corrosion-resistant metal trim and disk, reinforced neoprene diaphragm; 250 pound pressure class, minimum 175 degrees Fahrenheit temperature rating. Select valves for required flow rate, and inlet and outlet pressures.

f. Anti-siphon Valves: UL listed, bronze body, corrosion resistant spring-loaded poppet, resilient composition seat for tight shutoff, and dashpot. Cap shall have oil proof gasket. Valve shall be selected for the actual hydrostatic head from the top of the tank to the inlet of the fuel oil pump.

g. Safety Valves (1 inch and Smaller): Bronze body, automatic closing, corrosion-resistant spring-loaded with integral replaceable fusible link designed to melt at 165 degrees Fahrenheit (73.9 degrees Celsius)

allowing valve to tightly close. Valve shall be capable of manual opening and closing. Select valve type and size for fuel oil grade used.

h. Safety Valves (1-1/4 inch and Larger): Class 125, bronze body, automatic closing, corrosion-resistant, spring-loaded lever-operated gate valve. Valve shall be held open by stretched wire containing one or more fusible links designed to melt at 165 degrees Fahrenheit (73.9 degrees Celsius) allowing valve to tightly close. Provide a weight in accordance with valve manufacturer's recommendations where required to ensure reliable, quick closing of valve.

i. Solenoid Valves: Two-way, normally closed, copper alloy body, corrosion-resistant metal trim, 24VDC encapsulated coil with integral surge suppression. Electromagnetic solenoid shall be comprised of coil, core tube, core, enclosure, and leads. Select valve and accessories for fuel oil grade used.

4. Electric Motor Valve Actuators: Electric motor valve actuators shall conform to the requirements of AWWA C540 and shall have the following characteristics.

a. Type: Open-Close, reversing.

b. Open-Close Time for Ball Valves: 10 seconds.

c. Housing: NEMA 4X with corrosion resistant epoxy coating.

d. Power: 120 volt, 60 hz, single phase.

e. Controls: Local/Remote and Open/Stop/Close. Actuator to provide selectable 24VDC or 120VAC powered Open and Close inputs for remote control operation.

f. A declutching mechanism and handwheel to allow for manual operation of the valves

g. Position switches: Two (2) dry contact SPDT switches shall be provided for remote valve open and valve closed position indication.

h. Space heater and thermostat shall be provided in the housing.

i. Integral thermal overload protection shall be provided with automatic reset.

5. Piping Accessories:

a. Unions: ASME B16.39, Class 150.

1) Dielectric Unions: Union comprised of steel female pipe thread end and copper solder-joint end conforming to dimensional, strength, and pressure requirements of ASME B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a

corresponding bimetallic joint. When dry, it shall be able to withstand a 600-volt breakdown test.

b. Strainers: duplex basket type, with inlet and outlet on the same center line. Minimum 150 psig working pressure cast steel or cast iron body, 200 mesh minimum ASTM 300-series stainless steel or brass baskets. Open area of one basket shall be 2 1/2-times inlet or outlet piping area. Baskets shall be removable. Strainers shall have clamped covers.

F. Tank Fill And Vent Piping Systems:

1. Pipe and Fittings:

a. ASTM A53 Type E or S, Grade A or B, Schedule 40 black steel, with malleable iron threaded fittings, ASME B16.3.

2. Vent Caps:

a. Mushroom vent cap, galvanized cast iron construction with corrosion resistant screen, female pipe thread connection.

G. Tank Fill Station and Fuel Fill Control Panel (FF1-CP and FF2-CP):

1. Provide tank level switches, UL listed control panel and all accessories required for monitoring, alarming and control of the tank filling operation.

2. Fill Station cabinet with Fuel Fill Control Panels shall be provided for Storage Tank. The control panel shall be located above the fuel fill cabinet.

3. Panel shall provide tank level monitoring, fill valve control, overfill prevention and remote status monitoring for the tank filling operation.

4. Panel to interface with the Tank Gauging and Leak Detection system for tank level and tank leak signals and shall include level indicators in gallons

5. Panel shall be equipped with visual and audible alarms to alert fuel oil transfer operator. An automatic High Level alarm at 90 percent of tank capacity shall be provided for horn and beacon activation to alert the fill operator to stop the fill operation. If fill reaches 95 percent level the fill valve shall automatically close.

6. Fuel fill control panels FF1-CP for Tank 1 and FF2-CP for Tank 2 shall be relay based (no PLC or proprietary controllers) and shall comply with the requirements of Section 40 61 13 - PMCS General Requirements and related PMCS Sections. Control panels shall be NEMA4X, 316L stainless steel and shall include the following:

a. On/Off Power switch, Alarm Test and Alarm Silence pushbuttons, alarm horn and alarm beacon (amber).

b. Digital panel meter to display tank level in gallons.

c. Fill Valve Open pushbutton (red) to open the fill valve and Fill Valve Close pushbutton (green) to close the fill valve

d. Control Power (white), Tank Full (white), Tank High (amber) Fill Valve Open (red) and Fill Valve Closed (green) indicator lights.

e. Relay dry contacts for remote monitoring of Tank Full Level, Tank High Level Alarm, and Fill Box Sump Alarm.

f. Include a signal loop isolator to accept a 4-20mA Tank Level signal from the Tank Gauging and Leak Detection System.

g. Panel to accept a relay dry contact Tank Leak Alarm from the Tank Gauging and Leak Detection System. An active alarm shall prevent a tank filling operation, and during a filling operation the fill valve shall close and the alarm horn shall sound.

7. Horizontal Spill Container Fill Box:

a. Located in a separate lockable NEMA4X, Type 304L stainless steel enclosure below the Fuel Fill Control Panel.

b. The container has three point latch locking handle, 1/2" oil fill connection dry disconnect and dust cover, and redundant safety check valve.

c. Internal pre-plumbed check valves and shutoff valves.

d. Delivery type shall be to one tank.

e. Provide remote fully assembled fill port with the following features:

1) Material – stainless steel with hinged and lockable door.

2) 5 Gallon Spill Containment.

3) Inlet connections with quick couplers and dust caps.

4) Internal pre-plumbed check valves and shutoff valves

8. Spill Containment shall include a sump and drain plug and sump level switch for remote monitoring of sump alarm.

H. Corrosion Protection Systems:

1. Protective Coating Systems for Aboveground Steel Piping and Steel Tanks Located Outdoors:

a. Provide shop-applied painting system.

b. Protective coating shall be the products of one manufacturer and coating application procedure shall be in accordance with manufacturer's instruction. Tank surface preparation shall be abrasive blast clean steel surfaces in accordance with SSPC SP 10 to a surface profile of 1/2 to 2 mils (12.7 to 50.8 mm).

c. External Coatings: Protect aboveground piping and steel tanks against atmospheric corrosion with a coat of organic, lead and chromate free, zinc-rich primer conforming to SSPC Paint 20, Type II applied to a minimum dry film thickness of 4 mils (0.1 mm) and finish with two coats

of epoxy-polyamide topcoat. Apply a gray first finish coat, applied to a minimum dry film thickness of 3 mils (0.076 mm) and finish with a white second finish coat applied to a minimum dry film thickness of 3 mils (0.076 mm) resulting in a total system minimum dry film thickness of 11 mils (0.28 mm).

d. Internal Tank Lining: Tank surface preparation shall be abrasive blast clean steel surfaces in accordance with SSPC SP 10 to a surface profile of 1/2 to 2 mils (12.7 to 50.8 mm). Apply two coats of Chemliner 4000 with a minimum dry film thickness of 6 to 10 mils each. Follow manufacturer's recommendation with regard to application methods and conditions.

I. Pipe Hangers and Supports:

1. Provide hangers and supports in conformance with Section 40 05 07 - Hangers and Supports for Process Piping.

J. Tank Gauging and Leak Detection System:

1. Furnish and install a continuous surveillance automatic tank gauging (ATG) and leak detection (TGLD) system suitable for operation in a NFPA 70, Class 1, Division 1, Group D environment to detect fuel oil and water leaks.

2. The ATG and leak detection functionality shall be provided by means of a central processing controller/indicator with operator interface wired to fuel oil/water discriminating tank level probes and to a series of fuel oil/water discriminating leak sensors to detect water and fuel at any point within the total Secondary Containment System. The system shall be capable of continuously monitoring storage tank levels and secondary containment leaks, and the monitoring circuitry shall be designed so that any short, break, or cut in the sensors or connection cables, or tampering with the monitor, will set off an alarm.

3. The controller and its level probes and leak sensors shall be independently tested for intrinsic safety as well as for performance by a nationally recognized laboratory. System shall also be Third Party Certified and listed to meet EPA leak detection requirements.

4. System shall detect leakage into containment space by monitoring digital and electronic signals from leak sensors. Sensors shall be capable of operation in both a dry and wet environment. Audible and visual alarm leak alarms shall remain activated as long as the oil or water is present around the sensor. Sensors shall be compatible with a corrosion inhibitor used in containment spaces and shall detect leakage of liquid hydrocarbon. The following Containment Zones shall be monitored for fuel oil and water.

a. Zone 1 - Storage Tank

5. Liquid level probes:

a. Shall be Type 316 grade stainless steel and IP68 rated and use magneto strictive technology with multiple (typically 6) temperature sensing

devices to simultaneously provide fuel oil level, water level, and temperatures. Probes and controller software functionality shall provide dual mode monitoring and shall have accuracy of .01 inches in inventory mode and .001 inches in leak detection mode.

b. Fuel oil and water floats shall be 4" Buna-N and overall probe length shall be suitable for an 8' diameter steel tank. Probe length shall be coordinated with the tank supplier.

c. Level probe shall be installed in an accessible 4" NPT male riser pipe and shall be provided with a 4" cap with integral cable gland, floats, and all other required installation and wiring termination accessories.

d. All probe cabling (Belden 8761 typical) from probe to controller and all cable silicone splice kits shall be provided by the system manufacturer.

e. Leak detection sensors: Manufacturer's MS Windows compatible software for programming, system setup, sensor and display configuration, diagnostics, and database. Database to track and log all tank information, provide tank inventory and delivery dates, and alarm information. Software to be installed on operator workstation OWS1.

f. Include a minimum of six (6) rolls of thermal printer paper.

6. System spare parts to include the following:

a. One (1) complete level probe assembly.

b. Two (2) leak sensors of each type provided.

c. One (1) complete Controller with remote operator interface, same as provided.

d. One (1) thermal printer.

e. Thermal printer paper, fifty (50) rolls minimum.

7. The controller, level probes, leak sensors, software, and all required accessories shall be supplied by the same manufacturer.

8. System shall include a Tank Gauging and Leak Detection Control Panel (TGLD-CP) complying with the requirements of Section 40 61 13 - PMCS General Requirements, related PMCS Sections, and the Contract Drawings. The control panel shall include automatic tank gauging and leak detection controller with face of panel operator interface display, digital panel meters, and push to test type LED status and alarm indicator lights to simultaneously monitor, display, and alarm the following.

a. Control Power indicator light

b. Storage Tank Leak indicator lights

c. Fuel Fill Leak indicator lights

d. Generator Day Tank:

1) Level
2) Low Level and High Level indicator lights
3) Return pump - Run, Overload and Flow indicator lights
4) Tank Leak indicator light
5) Tank Transition Sump Leak indicator light

9. The TGLD-CP shall be provided with current loop isolators to repeat analog 4-20mA tank level signals to the monitoring FTP-CP.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Factory Testing of Fuel Oil Tank:

1. Provide hydrostatic testing of fuel oil storage tank to ensure tightness prior to shipment. The minimum pressure for testing tank shall be twenty-five (25) psi. The hydrostatic pressure shall be maintained until all joints and connections have been visually inspected for leaks, but in no case for less than one-half hour. The tank shall not show any permanent deformation as a result of the test. The test shall be run for no less than one-half hour. A copy of the test procedures shall be sent to the Engineer for review prior to testing. The City and/or the Engineer, at their discretion, shall observe this and all other tests.

B. Pump Set Testing:

1. Pump sets shall be factory tested prior to shipment. Testing shall include both pressure and vacuum testing periods. First, complete pump set shall be pneumatically tested at rated pressure for four hours. Next, complete pump set shall be vacuum tested at greater than 25 inches (63.5 cm) Hg for four hours. Following pressure and vacuum test, the pump set shall be given a full operational test with pump set connected to a fuel oil supply and return and operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within ten percent of rated motor amps. During the test, the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested. A certificate of factory testing, together with a copy of the wiring diagram and arrangement diagrams, shall be placed in the control cabinet prior to shipment.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Contractor's expense. Verify all measurements at job Site.

3.02 IMPLEMENTATION

A. Installation, workmanship, inspection, and testing shall be in accordance with the Codes specified in this Section with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping

and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping system clean during installation by means of plugs or other acceptable methods. When Work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

B. Piping and other apparatuses shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

C. Install piping to permit draining of all sections of the piping system without traps. Pitch piping down to system low points. Make piping provisions for priming of pumps.

D. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Make provisions in buried piping for differential settlement. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment and structure. Provide flexible connectors for vibration isolation of engine generators, oil burning equipment and pumps.

E. Steel Piping:

1. Steel piping 2 inches and smaller shall be threaded or socket-welded. Steel piping 2 1/2 inches and larger shall be buttwelded. Flanges may be used for valves and equipment connections. Piping joints shall conform to ASME B31.3.

F. Threaded Connections:

1. Provide lubricant or polytetrafluoroethylene tape on male threads of screwed joints. Red or white lead and zinc compound may be used. Lubricate threaded pipe joints, as well as bolts and studs used on high temperature pipe joints up to 1,050 degrees Fahrenheit, with anti-seize compound. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore and remove chips. Attach screwed flanges by screwing the pipe through the flange and reface pipe and flange accurately.

G. Welding:

1. Welding of Piping: Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards specified in Chapter VI of ASME B31.1.

2. Quality of Welds: Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.

3. Arc Welding and Gas Welding: ASME BPVC SEC IX, AWS Z49.1

H. Unions and Flanges:

1. Place unions and flanges wherever necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

I. Valves:

1. Install valves in positions accessible for operation and repair. Valves shall not be installed with stems below the horizontal position.

J. Fuel Oil Storage Tank:

1. Install storage tank, vents (normal and emergency), and other connections in accordance with the Codes specified in this Section, recommendations and published instructions of the manufacturer, and as indicated. Provide grounding of tank directly through ground rods or through bonding to grounded network in accordance with NFPA 780. Fasten aboveground fuel oil tank on a firm reinforced concrete foundation. Provide fireproofed steel supports between tank and foundation. Visually inspect the interior of fuel storage tank that have an accessible manhole to ensure it is free of debris before fuel is placed inside. Prior to entry, ensure a safe atmosphere exists.

K. Tank Gauging and Leak Detection System:

1. Install leak detection system in accordance with leak detection system manufacturer's instructions.

L. Paint all items specified in Section 09 91 00 - Painting.

3.03 FIELD TESTING / QUALITY CONTROL

A. Prior to initial operation, inspect systems for compliance with Contract Drawings, Contract Sections, and accepted submittals. As part of inspection, perform tests and flushing in compliance with the specified requirements. Have systems accepted by the Engineer before concealing.

B. Test Procedures and Reports:

1. Prepare and submit procedures, material, and equipment for all specified tests to the Engineer for acceptance prior to the planned tests. Material and equipment used in testing shall be subject to inspection by the Engineer.

2. Provide all material and labor required for testing. Instruments, test equipment, and test personnel required to properly conduct all tests shall be provided.

3. Repair defects disclosed by tests or, if required by the Engineer, replace defective Work with new Work without additional cost. If any deficiencies are revealed during test, such deficiencies shall be corrected, and the tests reconducted at no additional cost.

4. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case. When tests have been completed and corrections have been made, submit signed and dated test reports.

C. Perform pressure tests specified herein. Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated pressure gage in the system. In the event of leakage, locate and repair leaks by remaking joints and/or replacing pipe sections and repeat test. Materials and equipment used in

testing shall be subject to inspection by the Engineer. Provide electricity, instruments, connecting devices, and personnel for the tests. Correct defects in the Work and repeat tests until the Work is in compliance with contract requirements.

1. Carrier Piping Tests:

   a. Hydrostatic Test: Hydrostatically test each piping system using No. 2 or lighter grade fuel oil at 1.5 times maximum system operating pressure but in no case more than 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gage pressure for four hours.

   b. Vacuum Test: In addition to pressure tests, suction lines shall be tested under a vacuum of 20 inches water column maintained for at least 30 minutes.

2. Protective Coating Systems Tests:

   a. Inspect protective coating systems, with a holiday tester just prior to placement in ground. Holidays revealed shall be promptly repaired. Steel piping coating system shall be given a holiday test with a voltage of 2.54 to 5.08 mm thickness of the coating.

3. Fuel Oil Storage Tank Test:

   a. Storage tank leak tests shall be performed in accordance with NYC Building Code and NYSDEC PBS Regulations.

   b. The fuel oil system shall be tested and inspected by the Contractor in the presence of the NYC Fire Department. It is the Contractor's responsibility to obtain approval and storage permits from the NYC Fire Department.

   c. The fuel oil system shall be tightness tested in accordance with NYS DEC PBS regulations.

4. Leak Detection Test:

   a. Test the leak detection system in accordance with the manufacturer's testing procedure.

D. Flushing:

1. After completion of testing and before placing in operation, flush all fuel oil piping. Flush entire fuel oil piping system to remove all foreign matter. Use the permanent fuel oil storage tank for the source of flushing fuel oil. Flush piping through each connection to tank and equipment before connections are made. Flush until fuel oil runs clean. The Contractor shall provide fuel oil for flushing dispose of used fuel oil in accordance with applicable environmental control regulations.

E. Functional Testing:

1. All equipment, control devices, and signaling devices shall be tested individually to demonstrate proper operation. Test all control panel functions to demonstrate proper operation as per Section 40 80 82 – PMCS Startup and Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field painting system, under this Section in accordance with Section 09 91 00 - Painting.

B. Field touch-up all damaged factory or shop applied coatings for material and equipment furnished under this Section in accordance with the paint manufacturer's recommendations.

C. Do not apply field painting and touch-up until after installation and testing is completed and system accepted.

END OF SECTION

SECTION 23 31 14 – METAL DUCTS AND ACCESSORIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required, to furnish, install, and test all metal ductwork, with auxiliary equipment and accessories, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	14
2.04	Source Quality Control / Shop Tests	15
PART 3	EXECUTION	15
3.01	Examination / Preparation	15
3.02	Installation	15
3.03	Field Testing / Quality Control	20
3.04	Startup / Demonstration	20
3.05	Adjusting / Protection / Cleanup	20

C. The following schedule(s), attached after the end of section designation, are a part of this Section:

1. Schedule 23 31 14-1, Schedule of Metal Duct Construction Standards.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting.

B. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

C. Section 40 05 05 – Exposed Piping Installation.

D. Section 40 05 07 – Hangers and Supports for Process Piping.

E. Section 40 05 15 – Copper and Brass Process Pipe.

1.04 REFERENCES

A.	ASHRAE	Latest Edition.
B.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
C.	ASTM E437	Standard Specification for Industrial Wire Cloth and Screens (Square Opening Series)
D.	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
E.	SMACNA	HVAC Duct Construction Standards.
F.	SMACNA	Rectangular Industrial Duct Construction Standards
G.	SMACNA	Seismic Restraint Manual - Guidelines for Mechanical Systems.
H.	NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems.
I.	UL 181	Standard for Factory-Made Air Ducts and Air Connectors.
J.	UL 214	Standard for Tests for Flame-Propagation of Fabrics and Films.
K.	UL 555	Standard for Fire Dampers

1.05 DESCRIPTION

A. This Section includes requirements for providing metal ducts and accessories in accordance with applicable standards and regulations. In addition:

1. Metal duct and accessories shall include all painting, coating, lining, gaskets, harnesses, bolts, nuts, and other appurtenances and materials required to provide and assemble the lines.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and other authorities having jurisdiction.

1. Underwriters Laboratories, Inc.

2. National Fire Protection Association.

3. National Electrical Code.

4. Local and State Building Codes and Ordinances:

a. New York City Building Code.

b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. Engage a single firm, with undivided responsibility for performance and other requirements and components of the metallic ductwork.

2. Engage a firm which can show successful experience in the fabrication and erection for metallic ductwork systems of scope and type similar to the required Work.

C. Qualifications of Installer:

1. The Contractor shall have at least five (5) years' experience in the installation of the Work specified herein. The Contractor shall employ only tradespersons with specific skills and experience in this type of Work.

2. The Contractor shall have undivided responsibility as a single firm for performance and other requirements for the installation of the Work specified herein.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. The Contractor shall submit the following Shop Drawings and material specifications for the approval of the Engineer:

1) ¼-in. scale duct layouts, complete with.

a) Dimensions.

b) Details of construction.

c) Details of installation, hanger details, and spacing.

2) Manufacturer's literature, illustrations, specifications, and Engineering data for the following items, including weights of all component parts:

a) Registers, grilles, and diffusers.

b) Fire Dampers (UL Listed), including:

(1) Closing mechanisms.

(2) Fusible link operating temperature.

(3) Installation details.

c) Access Doors.

d) Duct Access Doors.

e) Flexible connections.

f) Duct sealants.

3) Details of sheet metal safing construction and installation.

4) An air outlet schedule indicating room name and location of each outlet. Cross reference contract designation and manufacturer's model number or name.

5) Details of construction and materials to the Engineer for all access doors to ensure the access door material matches the appearance of the finished Work.

b. Test Reports: Submit the following test reports for the following:

1) UL Label, Fire Dampers.

2) Volume Damper leakage tests from an AMCA-approved testing laboratory.

2. Information Submittals:

a. Contractor shall submit an affidavit stating that all stainless steel accessories (including, but not limited to: screws, hangers, supports, etc.) for stainless steel ductwork are Type 316 stainless steel.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. All ductwork shall arrive on Site fully fabricated, and not in two halves for field fabrication.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the materials and products provided under this Section, and as per the requirements of the Contract Documents. In addition, furnish the following spare parts:

1. Twelve (12) spare fusible links.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the products.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ductwork Accessories:

1. Transverse Duct Connections:
    a. Ductmate 35® System as manufactured by Duct Mate Industries Inc., Charleroi, PA.
    b. Or approved equal.
2. Volume Dampers:
    a. Ruskin Co., Grandview, MO.
    b. Or approved equal.
3. Rectangular Fire Dampers:
    a. Air Balance, Inc., Wyalusing, PA.
    b. Or approved equal.
4. Air Volume Extractors:
    a. Hart and Cooley, Grand Rapids, MI
    b. Titus, Plano, TX.
    c. Or approved equal.

B. Registers, Grilles, and Diffusers:

1. Supply Registers:
    a. A-J Manufacturing Co., Inc., Kansas City, MO.
    b. TITUS HVAC Co. Inc. Plano TX
    c. Price Industries, Suwanee, GA
    d. Or approved equal.
2. Air Turning Devices:
    a. AJ Manufacturing Co., Inc., Kansas City, MO.
    b. TITUS HVAC Co. Inc. Plano TX
    c. Price Industries, Suwanee, GA
    d. Or approved equal.

3. Exhaust and Return Registers:
   a. A-J Manufacturing Co., Inc., Kansas City, MO
   b. TITUS HVAC Co. Inc. Plano TX
   c. Price Industries, Suwanee, GA
   d. Or approved equal.
4. Exhaust and Return Grilles:
   a. A-J Manufacturing Co., Inc., Kansas City, MO.
   b. TITUS HVAC Co. Inc. Plano TX
   c. Price Industries, Suwanee, GA
   d. Or approved equal.
5. Transfer Grilles:
   a. A-J Manufacturing Co., Inc., Kansas City, MO.
   b. TITUS HVAC Co. Inc. Plano TX
   c. Price Industries, Suwanee, GA
   d. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Metal Ductwork:

1. General:
   a. All Work shall be constructed and installed properly in accordance with the recommendations given in the latest edition of SMACNA HVAC Duct Construction Standards and SMACNA Rectangular Industrial Duct Construction Standards.
   b. All ductwork shall be constructed in accordance with Schedule 23 31 14-1, Schedule of Duct Construction Standards, located after the "End of Section" designation.
2. Materials:
   a. All ductwork shall be constructed of Type 316 stainless steel and all duct accessories (e.g., air outlets, hardware, and fasteners, etc.) shall also be of Type 316 stainless steel, except as follows:
      1) Provide galvanized steel (G90, as per ASTM A653 coating) only where explicitly shown on the Contract Drawings. Air devices and ductwork accessories for galvanized ductwork shall be aluminum.
      2) Provide aluminum (with 3003 ductwork H-14 alloy and temper) only where explicitly shown on Contract Drawings.

Air devices and ductwork accessories for aluminum ductwork shall be aluminum.

3. Stainless Steel Ductwork:

   a. Stainless steel duct sheet thicknesses shall be two (2) gauges heavier than the thickness specified for galvanized steel duct in the SMACNA Duct Construction standards.

4. Connections:

   a. The transverse duct connections shall be bolted, gasketed connections.

5. Duct Elbows:

   a. Duct elbows shall have a minimum centerline radius of 1½ times the width of the duct.

6. Drip Pans:

   a. General:

      1) Provide drip pans, hangers, and supports for metal ductwork.

      2) Drip pan shall be of quantity and size as necessary and required to collect condensate from all metal ductwork and accessories that are part of this Work.

   b. Materials and Construction:

      1) Drip pans shall be constructed of 16-ga., Type 316 stainless steel.

      2) If welding is required to construct the drip pan, Type 316L stainless steel shall be used.

B. Ductwork Accessories:

1. Hangers and Supports:

   a. All ductwork shall be securely hung and anchored to the building structure.

      1) Unless otherwise explicitly shown on the Contract Drawings, hangers and stiffeners for ducts shall conform to all the recommendations and requirements given in the SMACNA HVAC Duct Construction Standards and the SMACNA Seismic Restraint Manual - Guidelines for Mechanical Systems.

      2) Unless otherwise specified herein, hangers and supports shall also conform to all the requirements of Section 40 05 07, Hangers and Supports for Process Piping.

b. Ducts shall be supported on trapeze hangers with angles or rods – the use of strap hangers, sheet metal duct hangers, and/or straps is prohibited.

c. Hanger rod thickness shall be as follows:

1) For all ducts with half-perimeter up to 72-in.: Hanger rods shall be minimum ⅜-in. thick.

d. For all ducts with half perimeter larger than 72 in.: Hanger rods shall be minimum ½-in. thick. A pair of rods shall be provided at each duct support point.

e. Support shall also be furnished at each fitting.

f. The maximum hanger spacing shall be as follows:

1) For ducts with half perimeter up to 72-in.: 8 ft

2) For ducts with half perimeter larger than 72-in.: 6 ft

g. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall be Type 316 stainless steel, except for use on galvanized steel ductwork, when such may be of galvanized steel construction.

h. Seismic Requirements:

1) All piping and ductwork shall be provided with seismic restraints in accordance with the SMACNA Seismic Restraint Manual – Guidelines for Mechanical Systems and in accordance with the New York City Building Code and referenced Uniform Building Code requirements.

2) Piping and ductwork shall be supported to withstand seismic forces anticipated in seismic zones 2A.

2. Sleeves:

a. Where ductwork passes through masonry walls, partitions, or floors, provide sleeves.

b. Material:

1) For stainless steel and aluminum ductwork: Provide sleeves of minimum 16 gauge, Type 316 stainless steel.

2) For galvanized ductwork: Provide sleeves of galvanized steel.

3. Volume Dampers:

a. Volume dampers shall comply with SMACNA Standards.

b. Materials:

1) For stainless steel ductwork: Provide manual volume dampers of Type 316 stainless steel construction.

2) For aluminum and galvanized steel ductwork: Provide manual volume dampers of and aluminum construction.

c. Blades: Opposed blades, vinyl edge seals.

d. Provide outside handle, quadrant, and approved position indicator and locking device.

e. Performance:

1) Damper Leakage: Not more than 16 cfm/ft^2 at 4-in. W.G.

4. Self-Acting Dampers:

a. Provide adjustable, counter-balanced type, with fabricated blades set in frame.

b. Materials:

1) For stainless steel ductwork: Provide self-acting dampers and frames of Type 316 stainless steel construction.

2) For aluminum and galvanized steel ductwork: Provide self-acting dampers and frames of aluminum construction.

5. Fire Dampers (Dynamic Type):

a. Provide fusible link fire dampers and access doors where indicated on the Contract Drawings and in accordance with the New York City Building Code. The fire dampers shall conform to all requirements of the latest edition of NFPA 90A and shall have a 1½ hr or 4 hr standard fire protection rating in accordance with the requirements of UL 555. All fusible links shall be UL rated at 165°Fahrenheit.

b. Materials:

1) For stainless steel and aluminum ductwork: Provide fire dampers of Type 316 stainless steel construction, with Type 316 stainless steel blades, interlocking joints, and fusible links.

2) For galvanized ductwork: Provide fire dampers of galvanized steel, with galvanized blades, interlocking joints, and fusible links.

3) Collars, angles, and hardware used for installing stainless steel fire dampers shall be Type 316 stainless steel.

c. Fire dampers shall be of the curtain type with interlocking blades set in a one-piece frame.

d. Fire dampers shall be suitable for installation in the vertical or horizontal position.

e. All fire dampers shall be Dynamic Rated for closure against airflow in the following six installation configurations:

1) Vertical Mount (Horizontal Airflow): Ducted and unducted.

2) Horizontal Mount (Airflow Up): Ducted and unducted.

3) Horizontal Mount (Airflow Down): Ducted and unducted.

f. Each fire damper shall be rated to close against maximum design airflow at its installed location with a 10% safety factor and against 8-in. w.g. maximum pressure across the closed damper.

g. Label:

1) All fire dampers shall have UL Label attached.

2) Label Materials:

a) For stainless steel and aluminum fire dampers: Provide label of Type 316 stainless steel construction.

b) For galvanized steel fire dampers: Provide label of galvanized steel construction.

3) Label shall have a fire rating of, at a minimum:

a) 1½ hrs for fire separations (walls, floors, and partitions) rated at 2 hrs.

b) 3 hrs for fire separations (walls, floors and partitions) rated at 3 hrs and above.

6. Sheet Metal Safing:

a. Provide insulated aluminum sheet metal safing to close off and seal airtight all unused areas behind louvers.

b. Insulation shall be 2-in. of thick rigid fiberglass, permanently sandwiched between two 16 ga. minimum metal sheets.

c. Insulation shall be secured to the sheets with adhesive.

d. The sheets, channels, and hardware used for the sheet metal safing shall be Type 316 stainless steel.

e. All edges of the panels shall be provided with a 16 ga. minimum channel secured in place with sheetmetal screws 6-in. on centers.

f. Insulated sandwich panels shall be removable type with maximum space of 18 in., and supported on 3-in. × 3-in. × ¼-in. angle. Provide intermediate supports.

7. Duct Access Doors:

a. Provide gasketed, cam lock cover type access doors in accordance with SMACNA Standards.

b. Construction:

1) Duct access doors shall be rigid and airtight, and provided with neoprene gaskets, hinges, and sash locks.

c. Materials: Each access doors shall be of the same material as the duct or duct accessory to which said access door shall be affixed.

d. Unless otherwise shown on the Contract Drawings or specified herein, access doors shall be of the following sizes:

1) For duct sizes under 14-in.: Provide 12-in. × 6 in. access doors.

2) For ducts sized 14-in.: Provide 12-in. × 12-in. access doors.

3) For duct sizes between 14-in. and 36 in.: Provide 21-in. × 14-in. access doors.

4) For duct sizes between 36-in. and 60-in.: Provide 25-in. × 17- in. access doors.

5) For ducts larger than 60-in.: Provide quantity two (2) 25-in. × 17 in. access doors.

e. Access doors for fire dampers shall be stenciled "FIRE DAMPER ACCESS" with minimum ½-in. high letters.

8. Flexible Connections:

a. Provide flexible connections in accordance with SMACNA HVAC Duct Construction Standards.

1) Flexible connections shall be for a pressure classification of 3 in. w.g.

b. Materials:

1) For galvanized steel ductwork: Provide 16 ga., 3-in. wide galvanized steel strip flexible connections.

2) For stainless steel ductwork: Provide Type 316 stainless steel flexible connections.

3) For aluminum ductwork: Provide 0.080-in. thick, 3-in. wide aluminum strip flexible connections.

9. Vibration Isolation Flexible Connections:

a. Provide flexible connections for preventing the transmission of vibrations through the ductwork at the locations specified herein.

b. Materials: Vibration isolation flexible connections shall be neoprene-impregnated fabric collars with cemented seams fastened with straps and bolts of the same material as the connecting ductwork.

10. Turning Vanes:
    a. Provide turning vanes in accordance with SMACNA HVAC Duct Construction Standards.
    b. Materials: Provide turning vanes of the same materials as ductwork in which they are installed.
    c. Construction: Vanes shall be of double thickness design.
11. Air Volume Extractors:
    a. Provide air volume extractors in accordance with SMACNA Standards.
    b. Material: Provide air volume extractors of the same material as the ductwork in which they are installed.
    c. Construction: Provide gang-operated curved adjustable blades controlled through manual adjusting lever.
12. Metallic Flexible Duct:
    a. Metallic flexible duct shall conform to UL 181 and shall be rated for positive or negative working pressure of minimum 5 in. w.g. at 250°Fahrenheit.
    b. Materials: Single-ply Type 316 stainless steel.
    c. Construction: Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180° with a throat radius equal to ½ duct diameter.
    d. Runout length shall be limited to 10 ft. and size limited to 8-in. in diameter.
13. “”Bird Screens and Frames:
    a. Bird screens shall conform to ASTM E437, Type I, Class 1, 2 by 2 mesh, 0.031-in. diameter stainless steel wire.
    b. Materials: Type 316 Stainless Steel.
    c. Frames shall be removable type stainless steel construction.
14. Hardware:
    a. Materials:
        1) All fastening devices used for aluminum and stainless steel ductwork and accessories shall be Type 316 stainless steel.
        2) All fastening devices used for galvanized and aluminum ductwork and accessories shall be galvanized.
        3) All gasketing material shall be butyl.

C. Registers, Grilles, and Diffusers:

1. General:
    a. Register, grille, and diffusers units shall distribute the volume of air (cfm) specified and/or as shown on the Contract Drawings.
    b. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance.
        1) Performance shall be certified according to ASHRAE 70.
        2) Inlets and outlets shall be sound rated and certified according to ASHRAE 70.
    c. Where the inlet and outlet openings are located less than 7 ft. above the floor, they shall be protected by a grille or screen according to NFPA 90A.
    d. Materials:
        1) For stainless steel ductwork: Register, grille, and diffuser units shall be of Type 316 stainless steel construction.
        2) For aluminum and galvanized steel ductwork: Register, grille, and diffuser units shall be of aluminum construction.
    e. Volume Dampers:
        1) Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable.
        2) Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers.
            a) Linear slot diffusers shall be provided with round or elliptical balancing dampers.
    f. Registers and Grilles:
        1) Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face.
        2) Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling.
        3) Grilles shall be as specified for registers, without volume control damper.
2. Supply Registers:
    a. Supply registers shall be double deflection type.
    b. Supply registers shall be provided complete with:

1) Adjustable vertical face bars

2) Key-operated opposed blade damper.

3. Air Turning Devices:

a. The air turning devices shall be provided complete with:

1) Two (2) sets of individually adjustable blades to equalize flow and control volume at collar takeoffs.

2) Gasketed perimeter.

4. Exhaust and Return Registers:

a. Exhaust and return registers shall be provided complete with:

1) Fixed vertical face bars, set straight.

2) Key-operated opposed blade damper.

5. Exhaust and Return Grilles:

a. Exhaust shall be provided complete with:

1) Fixed vertical face bars, set straight.

6. Transfer Grille Assembly:

a. Wall-mounted grille assemblies shall consist of two (2) grilles, installed flush to each side of wall.

b. A fire damper shall be installed between the grilles when located in fire rated walls.

1) The fire damper shall consist of a fully adjustable, key operated opposed blade damper with a spring loaded fusible link assembly and be of Type 316 stainless steel construction.

2) The fusible link shall be UL rated at 160°Fahrenheit.

c. The entire transfer grille assembly shall conform to the latest edition of the NFPA 90A.

d. Materials:

1) All transfer grille assemblies shall be of Type 316 stainless steel.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Stainless Steel Ductwork:

1. All stainless steel ductwork shall be shop fabricated in sections with welded flanged ends.

2. No field welding of stainless steel ductwork shall be permitted.

3. Welding equipment and electrodes shall be of a type specifically suited for welding light gauge Type 316 stainless steel to provide consistently good quality welds.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Field Measurements:

1. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.02 INSTALLATION

A. Metal Ductwork:

1. All ductwork shall conform accurately to the dimensions shown on the Contract Drawings, with the exception that:

a. Ductwork shall be as shown on the Contract Drawings, subject to such modifications as may be necessary to suit field conditions to clear any obstruction or conflicts with other equipment.

2. All ductwork shall be straight and smooth on the inside with neatly finished joints, and shall not be decreased at any point to avoid obstructions.

3. No piping, conduit, or structural work shall be installed in or through any ductwork.

4. All ductwork shall be run as close as possible to structural members, walls, and ceilings.

5. Where existing walls, floors, or roofs must be penetrated, Contractor shall neatly cut the required openings and patch the existing wWrk to provide a neat and finished appearance.

6. Ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.

7. Install all ductwork and accessories to provide a system free from buckling, warping, breathing, or vibration.

8. Where required, and as shown on the Contract Drawings, the Contractor shall provide blank off baffles to eliminate drafts caused by nearby obstructions.

B. Ductwork Joints:

1. After the installation is completed, the Contractor shall seal all joints.

2. Tape and seal all joints as per SMACNA Duct Construction Standards.

3. Sealants and tape shall have the following ratings:
    a. Flame Spread Rating, as per ASTM E84: ≤ 25
    b. Smoke Developed Rating: ≤ 50
4. Flanged duct joints shall be 0.25-in Butyl gasketed and bolted together with stainless steel (Type 316) bolts, nuts, washers and lock washers.
5. All metal duct joints shall be airtight with no leakage.

C. Coordinate all air outlets for compatibility with ceiling system.

D. Sleeves:
1. Caulk sleeves airtight with fire resistant sealant between sleeve and ductwork..

E. Floor Openings:
1. Curbs to prevent water leakage shall be provided around all floor openings.
2. Where concrete curbs are not shown on the Contract Drawings:
    a. Provide curbs fabricated of 4-in. × 4-in. × ¼-in. thick angles with welded corners.
    b. The curb shall be set in a mastic compound and securely fastened to the floor to provide a watertight installation.
3. Curbs associated with stainless steel ductwork shall be fabricated of Type 316 stainless steel.

F. Turning Vanes:
1. The turning vanes shall be quiet and free from vibration when the system is in operation.
2. Turning vanes shall be double thickness type.
3. Turning vanes shall be installed in the following locations:
    a. All miter elbows to permit air to make the abrupt turns with a minimum of turbulence.
    b. All collar take-offs to supply registers.
    c. All short radius elbows in accordance with SMACNA standards and Industrial Duct Construction standards.
4. Duct clean out doors shall be provided at each elbow with turning vanes.

G. Volume Dampers:
1. Manual volume dampers larger than 11-in. in any dimension shall be opposed blade type.
2. The damper blades shall be operated by a lockable dial regulator and may be set in any position.

a. The dial regulators shall be marked so that the "open" and "shut" positions are clearly identified.

b. The dial regulators on insulated ductwork shall be mounted on an elevated platform which will finish flush with the surface of the insulation.

3. Manual volume dampers shall be located at accessible points and, wherever possible, some distance from a duct transition or fitting.

4. Care shall be taken during installation to make certain that sheet metal fasteners do not protrude into the duct and interfere with damper operation.

5. Install volume dampers where indicated on the Contract Drawings and as required to facilitate accurate volume control. Volume dampers specified with air devices shall be installed in addition to those shown on the Contract Drawings. In addition, dampers shall be installed in all of the following locations:

a. Each branch duct take off, and

b. In both ducts downstream of each trunk duct split.

c. An additional volume damper shall be installed in duct stub to each air outlet for balancing of air volume.

H. Splitter type dampers are not permitted and shall not be installed.

I. Duct Access Doors:

1. Duct access doors shall be provided in all of the following locations for inspection and maintenance:

a. Within working distance of (and on the fusible link side of) all fire dampers.

b. Adjacent to all dampers.

c. On the linkage side of all automatic dampers.

d. At all other apparatus requiring service or inspection in the duct system.

2. Whenever space requirements are such that a hinged access door is impractical, a screw fastened lift-out door shall be provided instead.

J. Access Doors:

1. Provide access doors for all concealed valves, controls, test openings, duct access doors, and at all other locations requiring service, inspection, and/or adjustment of a concealed item. Behind finished Work such as walls, plaster, and wood paneling, and in suspended ceilings which do not have removable panels. The access doors shall match the appearance of the finished Work in which they are installed and shall be of sufficient size to permit service, inspection, and/or adjustment of the concealed item.

K. Test openings:

1. The test openings shall be sealed by a screw cap and gasket, and shall be installed so that the insulation is not disturbed when the cover is removed.
2. The test openings shall be located as follows in all heating, ventilating, and air conditioning systems:
    a. In the outside air duct adjacent to the unit.
    b. In the exhaust air duct adjacent to the unit.
    c. In the main supply duct on each unit.

L. Flexible Connections:

1. All expansion joints in ducts at building expansion joints shall be suitably supported at each end by support guides within 12-in. of joint.
2. All ducts at flexible connections with air handling equipment, and fans shall be supported at free end within 12-in. of flexible connection.
3. Provisions shall be made for supporting all ductwork, dampers, and other ductwork accessories, where necessary.

M. Vibration Isolation Flexible Connections:

1. Install vibration isolation flexible connections between the ductwork and all air moving equipment and at the building joints.
    a. Provide flexible connections at both the inlet and discharge of air for all handling equipment.
2. Vibration isolation flexible connections shall not be painted or used to correct misalignment.

N. Fire Dampers:

1. Fire dampers shall be installed where shown on the Contract Drawings and where required by UL and authorities having jurisdiction, and shall be approved by local building codes and in accordance with the requirements of the NFPA.
    a. Two (2) fire dampers, rated at 1½ hours each, with one on each face of the fire separation or fire division, are required for fire separations having a 3-hr fire rating or above as per the New York City Building Code and Uniform Building Code requirements.
2. Fire dampers shall be secured to a Type 316 stainless steel collar with ¼-in. diameter stainless steel nuts and bolts with maximum spacing of 12-in. on center and a minimum of two (2) fastenings per side, beginning 2-in. in from the corners of the collar.
3. The collars shall be at a minimum the same gauge as the ductwork to which the collar is attached or 24 ga. thick (Type 316 stainless steel), whichever thickness is greater.

4. Retaining angles shall be installed on four sides of the collar and on both sides of the protected opening with a minimum of 1-in. overlap on the wall or floor.
    a. The Type 316 stainless steel angles shall be a minimum of 1½-in. × 1½-in. × ⅛-in. and shall be fastened to the collar only – do not fasten angles to the wall or floor.
    b. The retaining angles shall be increased in size to provide the minimum overlap of one inch on the wall or floor.
    c. The angles shall be fastened to the collar with ¼-in. diameter stainless steel nuts and bolts with a maximum spacing of 6-in. on center and a minimum of two (2) fastenings per side, beginning 2-in. from the corners of the collar.
    d. Where gas tight seals are required, the angles shall be fastened to the collar with a continuous weld and a sealant shall be installed between the angle and the wall or floor.
5. Clearance for expansion is required between the collar and the opening on the top and on each vertical side.
    a. The clearance shall be ⅛-in. per linear ft. of sleeve, with clearance on the sides distributed equally and all vertical clearance on the top.
6. The ductwork shall be connected to the collar on each side of the wall or floor with a breakaway connection on all four sides of the collar.
    a. The distance from the wall or floor to the breakaway connection shall not exceed 6-in..
7. Provide firestopping at fire separations where fire dampers are installed.
8. Provide an access door in duct at each fire damper located in duct.

O. Prefabricated Roof Curbs:
1. Install before the installation of roofing.

P. Contractor shall furnish and install sleeves for registers, grilles, and dampers mounted in the masonry, concrete plenums, or shafts. Sleeves shall be 16 ga. Type 316 stainless steel.

Q. Sheet Metal Safing:
1. Install safing to seal off remaining portions of shafts and louvers which are not covered by the plenums or equipment attached to the shaft or louver.

R. Drip Pans:
1. Route drain pipe of a diameter necessary and required from drip pan to nearest plant drain in accordance with the requirements of Section 40 05 05 - Exposed Piping Installation.

2. Drain pipe shall be of copper or brass as per Section 40 05 15 - Copper and Brass Process Pipe.

3. Install and restrain drain pipe as per Section 40 05 05 - Exposed Piping Installation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjustment:

1. Set volume control devices for approximate positions in preparation for final testing and balancing.

2. Install fusible links in fire dampers and verify that dampers are in open position.

3. Start fan system and check for excessive leaks and vibration and correct.

B. Balancing:

1. Systems shall be completely tested, adjusted and balanced by a qualified engineer. A complete balancing procedure shall be submitted for approval. All equipment and connections required to balance the systems shall be provided.

2. All duct systems shall be balanced as specified in Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

C. Cleaning:

1. Remove all loose materials and obstructions from interior of ducts.

2. Remove debris and waste materials resulting from installation.

D. Painting:

1. Surface Preparation and Shop Painting:

a. Clean and prime coat ferrous metal surfaces of equipment in the factory/shop in accordance with the requirements of Section 09 91 00 - Painting.

b. Coat polished and non-ferrous metal surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operations.

2. Field Painting:

a. Painting required for exterior surfaces of ductwork and insulation, and finish painting of items only primed at the factory, are specified in Section 09 91 00 - Painting.

END OF SECTION

SCHEDULE 23 31 14-1
SCHEDULE OF METAL DUCT CONSTRUCTION STANDARDS [1,2]

Service:	**Pressure Classification: (in. W.G.)**	**Construction Standards:**
All ductwork on fan discharge side	+3	SMACNA HVAC Duct Construction Standards
All ductwork on suction side	-3	
Transfer air duct not connected to fan	±2	

Notes:

1. All accessories (including, but not limited to: turning vanes, air turning devices, manual volume dampers, motor operated control dampers, fire dampers, access doors, supports, angles, clamps, hangers, and hardware) shall be suitable for the pressure classification given above.
2. Ductwork Material Schedule: Refer to the Contract Drawings.

SECTION 23 33 00 – REFRIGERANT PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all HVAC refrigerant piping.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	8

C. All HVAC refrigerant piping shall be provided in accordance with what is shown on the Contract Drawings and approved submittal data and drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 – Miscellaneous Metal Fastenings

B. Section 10 14 01 - Identifying Devices

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society For Testing and Materials International
4.	AWS	American Welding Society
5.	ANSI	American National Standards Institute
6.	CDA	Copper Development Association

B. Reference Standards:

1.	ASHRAE 15	Safety Standard for Refrigeration Systems
2.	ASHRAE 34	Designation and Safety Classification of Refrigerants
3.	ASME B31.5	Refrigerant Piping and Heat Transfer Components
4.	ASTM B280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
5.	AWS A5.8/A5.8M	Filler Metals for Brazing and Braze Welding
6.	ANSI B16.22	Wrought Copper and Copper Alloy Solder
7.	CDA A4015	Copper Tube Handbook

1.05 DESCRIPTION

A. This Section includes requirements for providing HVAC Refrigerant Piping in accordance with applicable standards and regulations. In addition:

1. HVAC Refrigerant piping shall be furnished completely with all accessories, special tools, spare parts, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances.
    a. Building Code of the City of New York.

b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Installer:

1. Prior to installation, submit data showing the name and license of the installing contractor and that he has successfully installed systems of the same type and design as specified herein. Data shall include names and locations of at least two installations of such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. The installing contractor shall be licensed to perform applicable ductwork and piping systems installation in the state in which the Project is located.

C. Qualifications of Construction Supervisor:

1. Provide a Construction Supervisor with a minimum of five years of experience in HVAC construction supervision who shall be responsible for the installation of the Work of this Section. The Construction Supervisor shall be licensed to perform applicable HVAC systems supervision in the state in which the Project is located. Prior to installation, submit data for acceptance showing the name and license of the Construction Supervisor.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Pipe and Fittings

b. Refrigerant Piping and Accessories

c. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

d. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

e. Details of corrosion resistance coating.

f. Detailed specifications and data sheets for all accessories. etc.

g. Shop and field-testing procedures.

h. Deviations from the Contract Documents.

2. Information Submittals:

a. Reports of Certified Shop Tests

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of refrigerant piping for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Refrigerant piping, fittings, and accessories shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. HVAC Refrigerant piping, fittings, and accessories shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust all refrigerant piping.

1.10 WARRANTY

A. None

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 MATERIALS / EQUIPMENT

A. General:

1. Refrigerant Piping shall be coordinated with and installed per the equipment manufacturer’s recommendations.

B. Refrigerant Piping:

1. General:

a. Refrigerant piping shall be type L hard drawn copper tubing cleaned, dehydrated, and capped for refrigerant service conforming to ASTM B280

b. Refrigerant piping shall have wrought copper brazed joint pressure fittings conforming to ANSI B16.22

c. All joints shall be made using a brazing alloy containing silver or using a copper- phosphorous alloy

2. Construction:

a. Install all refrigerant piping in accordance with the requirements of ASME Standard B31.5, refrigerant piping; and ASHRAE Standard 15, standard safety code for mechanical refrigeration.

b. All refrigerant piping shall be installed to ensure that all oil returns to the compressor.

c. Suction line piping shall be sized on a pressure drop between the evaporator and compressor equal to an equivalent temperature of not greater than 2 degrees Fahrenheit, with a velocity in the vertical rise of not less than 1,000 fpm. Liquid line piping shall be sized on a pressure drop not to exceed 5 psig. Provide the minimum number of piping joints to limit refrigerant leaks.

d. Refrigeration system installation shall be in accordance with all state and local codes.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Anchorage Devices:

1. Provide anchorage devices in accordance with Section 05 05 23.02 – Miscellaneous Metal Fastenings.

B. Identification:

1. Provide in accordance with Section 10 14 01 - Identifying Devices.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for replacement.

3.02 INSTALLATION

A. Install HVAC refrigerant piping, fittings and accessories in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.9. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other accepted methods. When Work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

2. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written acceptance. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made. Pipe shall be purged with nitrogen and capped until refrigerant line is charged. Changes in direction shall be made with fittings; bending of pipe will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

B. Pipe Joints:

1. Brazed and Soldered Joints

a. Brazing and soldering procedure qualification shall conform to ASME B31.1. Brazing procedure for joints shall be as outlined in the CDA A4015.

b. Soldering, soldering preparation, and procedures for joints shall be in accordance with ASME B31.1 and as outlined in the CDA A4015.

c. Copper tube extracted joints shall not be permitted.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract documents. In addition:

1. Refrigerant Leakage Test: After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a refrigerant leakage test. The refrigerant leakage test shall be done with dry nitrogen before any refrigerant pipe is insulated or covered. High and low side of the refrigerant system shall be tested for the minimum refrigerant leakage test pressure specified in ASHRAE 15, for the refrigerant employed in the system. System shall be proved tight and free of leaks by allowing the refrigerant leakage test pressure to remain on the system for 24 hours with no drop in pressure. The initial test pressure and surrounding air temperature will

be recorded. After the 24 hour hold period, the final system pressure and surrounding air temperature will be recorded. A correction of 0.3 psi shall be allowed for each degree Fahrenheit change in the initial and final temperature of the surrounding air, plus for an increase and minus for a decrease. The system shall have passed the refrigerant leakage test if the corrected final system pressure is equal to the initial system test pressure. If the pressures are not equal, the leaks shall be located and repaired.

2. Refrigerant Leaks: To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking or remelting and adding more brazing material will not be acceptable. After leak repairs have been made, the refrigerant leakage test shall be conducted again.

3. System Charging and Startup Test: Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

4. Evacuation Test: After the foregoing tests have been satisfactorily completed and the pressure relieved, entire system shall be evacuated to an absolute pressure of 300 microns During evacuation of the system, the ambient temperature shall be higher than 35 degrees Fahrenheit. Vacuum line shall be closed, and the system shall stand for one hour. After this period, the absolute pressure shall not exceed 500 microns. If the pressure rises over 500 microns, the system shall continue to be evacuated until the system reaches 300 microns and can stand for one hour with the vacuum line closed without the absolute pressure rising over 500 microns. During evacuation, pressures shall be recorded by a thermocouple type, electronic type, or a calibrated-micron type gauge.

5. System Performance Tests: After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by an accepted manufacturer's startup representative experienced in system startup and testing, at such times as directed. Tests shall cover a period of not less than five days for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made and tests shall be re-conducted to demonstrate that the entire system is functioning as specified.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of

HVAC refrigerant piping in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.
2. The Contractor shall include instruction on care and maintenance of HVAC refrigerant piping fans in the training of plant personnel.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. None.

B. Protection:

1. HVAC Refrigerant piping shall be protected as per the requirements of the Contract Documents. The use of refrigerant systems shall not be permitted until permission is given by the Engineer.
    a. When permission is given, the Contractor shall operate each HVAC fan to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean of the installed HVAC refrigerant piping and remove all debris and waste materials resulting from installation.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all HVAC fans completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	23
2.04	Source Quality Control / Shop Tests	24
PART 3	EXECUTION	24
3.01	Examination / Preparation	24
3.02	Installation	25
3.03	Field Testing / Quality Control	25
3.04	Startup / Demonstration	25
3.05	Adjusting / Protection / Cleanup	25

C. All HVAC fans shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 – Miscellaneous Metal Fastenings

B. Section 09 91 00 – Painting

C. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

D. Section 26 05 91 – Low-Voltage Electric Motors

E. Section 40 05 96 – Vibration and Seismic Controls

F. Section 40 05 97 – Identification for Process Equipment

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	FRP	Fiber Reinforced Plastic

B. Reference Standards:

1.	AISI C1045	Medium Carbon Steel
2.	AMCA 210	Laboratory Methods of Testing Fans for Ratings
3.	AMCA 301	Methods for Calculating Fan Sounds Ratings from Laboratory Test Data.
4.	ANSI S2.19, G6.3	Mechanical Vibration - Balance Quality Requirements Of Rigid Rotors

5. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems

1.05 DESCRIPTION

A. This Section includes requirements for providing HVAC fans and accessories in accordance with applicable standards and regulations. In addition:

1. HVAC fans shall be furnished completely with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards of the organizations and regulatory agencies below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances
    a. Building Code of the City of New York.
    b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. All components of the HVAC fans shall be provided by the Contractor through a single HVAC fan vendor.

a. The Contractor (through the HVAC fan vendor) shall have the sole responsibility of matching all components and providing equipment which functions together as a system.

2. The HVAC Fans shall be standard equipment of the manufacturer.

3. The HVAC fans shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.

4. All fans shall be selected from performance curves and not from rating tables.

a. Performance data for all fans shall be based on tests conducted in accordance with AMCA 210 and shall be licensed to bear the AMCA certified rating seal for both sound and air performance.

5. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

b. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

c. Fan performance curve indicating the operating point.

d. Details of corrosion resistance coating.

e. Weights of assembled units.

f. Motor nameplate data as specified in Section 26 05 91 – Low-Voltage Electric Motors.

g. Detailed specifications and data sheets for all accessories such as roof curbs, dampers, damper operators, disconnect switches, vibration isolators, etc.

h. Example equipment nameplate data sheet.

i. Schematic diagrams for electric and control systems showing wiring for individual equipment items and interconnecting wiring diagrams.

j. Shop and field testing procedures.

k. Deviations from the Contract Documents.

l. Wiring diagrams with numbered terminal blocks for all external connections.

m. Description of control system.

n. Motor Tests and Data: For each motor submit a certified motor test data sheet or a certified motor data sheet from an electrically duplicate motor, in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

o. List of recommended lubricants.

p. Operation and maintenance manuals

q. Fan manufacturer shall provide sound power ratings in the eight octave bands.

1) Sound power levels shall be based on AMCA Standard 301.

2) Sound power ratings shall be in decibels, referenced to 10^{-12} W.

2. Information Submittals:

a. Spare Parts List

b. Special Tools List

c. Reports of Certified Shop Tests

d. AMCA Approval for Fan Ratings

e. List of Lubricants:

1) The manufacturer shall submit a list with a minimum of four (4) manufacturers' standard lubricants which may be used interchangeably for each type of lubricant required.

a) The Contractor shall utilize this list in preparing his comprehensive lubrication survey as described in the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the HVAC fans for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The HVAC fans shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The HVAC fans shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

1. Provide the following spare parts for up to every four (4) of the same size, model, and type of HVAC fan furnished under this Section:

a. One (1) blower with wheel

b. One (1) set bearing and seal

c. One (1) set sheave

d. One (1) shaft

e. Two (2) sets of belts for each belt driven fan

2. Provide electric motor spare parts in accordance with Section 26 05 91, Low Voltage Electric Motors.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In-line Cabinet Fans:

1. Greenheck, Schofield, WI;

2. Loren Cook, Springfield, MO

3. Twin City Fan & Blower, Minneapolis, MN;

4. Or approved equal.

B. Centrifugal Base Mounted Fans

1. Greenheck, Schofield, WI;

2. Loren Cook, Springfield, MO

3. Twin City Fan & Blower, Minneapolis, MN;

4. Or approved equal.

C. In-Line Square Centrifugal Fans:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

D. Up-Blast Roof Mounted Centrifugal Fans:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

E. Roof Mounted Axial Type Supply Fans:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

F. Roof Mounted Axial Type Exhaust Fan:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

G. In-Line Centrifugal Stainless Steel Fans:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

H. Roof Mounted Centrifugal Exhaust Fans:
   1. Greenheck, Schofield, WI;
   2. Loren Cook, Springfield, MO
   3. Twin City Fan & Blower, Minneapolis, MN;
   4. Or approved equal.

I. Tube Axial Upblast Roof Exhaust Fan:

1. Greenheck, Schofield, WI;
2. Loren Cook, Springfield, MO
3. Twin City Fan & Blower, Minneapolis, MN;
4. Or approved equal.

J. Tubular Centrifugal Inline Duct Fans:

1. Provide fans as manufactured by:
   a. Greenheck, Schofield, WI;
   b. Loren Cook, Springfield, MO
   c. Twin City Fan & Blower, Minneapolis, MN;
   d. Or approved equal.
2. Coating system shall be as manufactured by:
   a. Heresite Protective Coatings, Manitowoc, WI;
   b. Greenheck, Schofield, WI;
   c. Loren Cook, Springfield, MO
   d. Twin City Fan & Blower, Minneapolis, MN;
   e. Or approved equal.

K. Wall Mounted Propeller Fans:

1. Provide fans as manufactured by:
   a. Greenheck, Schofield, WI;
   b. Loren Cook, Springfield, MO
   c. Twin City Fan & Blower, Minneapolis, MN;
   d. Or approved equal.
2. Propeller coating system shall be as manufactured by:
   a. Heresite Protective Coatings, Manitowoc, WI;
   b. Greenheck, Schofield, WI;
   c. Loren Cook, Springfield, MO
   d. Twin City Fan & Blower, Minneapolis, MN;
   e. Or approved equal.

L. Fiberglass Axial Roof Fans:

1. Aerovent, Minneapolis, MN;
2. Greenheck, Schofield, WI;
3. Or approved equal.

M. Fiberglass Inline Axial Flow Duct Fans:

1. Aerovent, Minneapolis, MN;
2. Air Plastics, Inc., Avon Lake, OH;
3. Greenheck, Schofield, WI;
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Fans shall be as shown on the Contract Drawings.
   a. The capacity of all HVAC fans shall be as shown on the Contract Drawings.
   b. Where shown on the Contract Drawings, explosion proof motors and AMCA Type "A" spark resistant construction HVAC fans shall be provided.
2. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
3. Motors:
   a. Motors shall comply with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.
   b. Unless otherwise indicated, motors shall be of the totally enclosed premium efficiency fan cooled type.
   c. Motors shall not be selected for operation in the service factor range/zone. The maximum brake horsepower required at any point on the performance curve shall not exceed the rated horsepower of the motor.
4. Electrical Service:
   a. Motors ≤ ⅓ hp : 115V, single phase, 60 Hz.
   b. Motors ≥ ½ hp : 460V, 3-phase, 60 Hz
5. Two speed motors: Shall be two winding type.
6. Disconnect Switches: All fans and damper operators shall each be provided with individual externally mounted disconnect switches.
7. Enclosures:
   a. All enclosures shall be NEMA 4X, and of stainless steel construction, unless otherwise shown on the Contract Drawings.
   b. NEMA 7 enclosures shall be provided where shown on the Contract Drawings. In explosion proof areas:

1) HVAC fans shall be of AMCA Type A spark resistant construction shall be provided.

2) Fans shall have all parts in contact with gas fabricated of non-ferrous materials; bearings shall not be located in the gas stream.

3) Explosion proof fans shall be provided with NEMA 7 explosion proof disconnect switches, explosion proof damper operators, and explosion proof motors.

8. Bearings:

a. All fan bearings shall be selected for a minimum L-50 life of 100,000 hrs at maximum operating speed.

9. Shafts:

a. All shafts shall be sized so the first critical speed is at least 20% over the maximum operating speed.

b. Close tolerance shall be maintained along the length of the shaft.

10. Drive Type:

a. The fans shall be either direct connected or V-belt drive as indicated on the HVAC Fan Schedule shown on the Contract Drawings.

b. V-belt Drives:

1) V-belt Drives shall have the following rated capacities:

a) For motors ≤ 10 hp: 120% of rated capacity.

b) For motors > 10 hp, 150% of rated capacity.

2) All V-belt drives shall be provided with adjustable sheaves.

3) Belt Guards:

a) Exposed V-belt drives shall have removable belt guards with openings to allow for tachometer readings at both drive and fan shafts.

b) Guards shall be so constructed as to allow visual inspection of the belts without removing the guard.

c) All belt guards shall be OSHA-approved.

d) Exterior, exposed belt guards shall be weatherproof.

11. Seismic Restraints:

a. All fans shall be secured or anchored to withstand seismic forces anticipated in seismic zone 2A.

b. Equipment shall be provided with seismic restraints in accordance with SMACNA Seismic Restraint Manual: Guidelines for

Mechanical Systems, as published by, and in accordance with the latest edition of the City of New York Building Code and referenced Uniform Building Code requirements.

12. Vibration isolators:

a. All vibration isolators shall be provided in conformance with the requirements of Section 40 05 96 – Vibration and Seismic Controls.

b. Isolators shall have a minimum efficiency of 90%.

c. Installation, type, number, and size of vibration isolators shall be in conformance with the manufacturer's recommendations for the frequencies involved.

B. In-line Cabinet Fans:

1. General:

a. The fan wheel(s) shall be of the forward curved centrifugal type and shall be dynamically balanced.

2. Construction:

a. Housing:

1) The fan housing shall be constructed of heavy gauge galvanized steel.

2) The housing interior shall be lined with ½–in. acoustical insulation.

3) The outlet duct collar shall include an aluminum backdraft damper and shall be adaptable for horizontal or vertical discharge.

b. Wheel:

1) Fan wheels shall be constructed of galvanized steel.

c. Motor Base:

1) The motor shall be mounted on vibration isolators.

3. Controls:

a. Direct drive fans shall be provided with solid state speed control as required.

b. The access for wiring shall be external.

c. The motor disconnect shall be externally mounted.

C. Centrifugal Base Mounted Fans:

1. General:

a. Centrifugal base mounted fans shall be of the airfoil bladed single inlet centrifugal type.

b. Fans shall be suitable for floor mounting.

2. Construction:

a. Housing:

1) Fans shall be of all aluminum construction conforming to AMCA "B" spark resistant construction.

2) All hardware shall be Type 316 stainless steel.

3) Stainless steel parts to be mill finish.

b. Wheel:

1) Wheels to have aluminum back plate, shroud, and airfoil blades.

c. Belt Guard:

1) Belt guard shall be of aluminum construction.

d. Bearings:

1) Fan bearings to be provided with aluminum lubrication lines extended to a common point on the bearing stand.

2) The bearing supports shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings, bearings shall be heavy duty, self-aligning pillow block ball bearings, and grease lubricated.

3) Shafts shall be turned, ground, polished, and rust protected.

e. Motor Base:

1) Adjustable motor mounting base to be fabricated of 316 stainless steel.

3. Drive:

a. Adjustable drive assemblies to have static resistant belts.

4. Accessories:

a. Fans shall be provided with access door, companion flange, motor operated dampers, and inlet boxes.

b. Fans shall be provided with housed spring type vibration isolation for a minimum of 95% isolation efficiency and having spring assemblies with rubber coated springs.

D. In-Line Square Centrifugal Fans:

1. General:

a. In-line square fans shall be of centrifugal belt driven in-line type.

2. Construction:

a. Housing:

1) The fan housing shall be of the square design constructed of heavy gauge all aluminum and shall include square duct mounting collars.

b. Wheel:

1) The fan wheel shall be centrifugal backward inclined, constructed of aluminum, and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

2) Wheels shall be statically and dynamically balanced.

c. Shaft:

1) Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.

3. Drive:

a. Motors and drives shall be mounted out of the airstream with combination motor cover and belt guards.

b. Motors shall be readily accessible for maintenance.

c. Pulleys shall be of the fully machined cast iron type, keyed, and securely attached to the wheel and motor shafts.

d. Motor pulleys shall be adjustable for system balancing.

4. Accessories:

a. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel.

1) The access panels must be of sufficient size to permit easy access to all interior components.

E. Up-Blast Roof Mounted Centrifugal Fans:

1. General:

a. Roof exhaust fans shall be up-blast centrifugal belt driven type.

2. Construction:

a. Housing:

1) The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure.

2) Windbands shall have a rolled bead for added strength and shall be joined to curb caps with a welded seam.

b. Wheel:

1) The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

2) Wheels shall be statically and dynamically balanced.

3. Shaft:

a. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.

4. Motor Base:

a. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

5. Drive:

a. Motor pulleys shall be adjustable for final system balancing.

b. Motors and drives shall be mounted on vibration isolators, out of the airstream.

c. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants.

d. Motors shall be readily accessible for maintenance.

e. Pulleys shall be of the fully machined cast iron type, keyed, and securely attached to the wheel and motor shafts.

6. Controls:

a. A disconnect switch shall be externally mounted within NEMA 4X stainless enclosures.

b. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

7. Accessories:

a. Fans shall be provided with 12-in. high insulated prefabricated heavy gauge aluminum roof curb with liner and nailer, dampers and damper access section.

F. Roof Mounted Axial Type Supply Fans:

1. General:

a. Roof mounted supply fan shall be belt driven and axial type hooded propeller roof fans.

2. Construction:

a. Housing:

1) Fan hood and base construction shall be aluminum.

2) Hood panels shall be arched with interlocking ribs.

3) Fan bases shall be tall bases.

4) Access doors shall be provided for inspection and service of damper and actuator.

5) Hood support angles shall be heavy gauge galvanized steel.

6) Bird screens of ½-in., Type 316 stainless steel mesh shall be horizontally mounted in the perimeter of the hood.

b. Propeller:

1) Propellers shall be constructed with cast aluminum blades and hubs. Propellers shall be securely attached to fan shafts.

2) All propellers shall be statically and dynamically balanced.

c. Shaft:

1) Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks.

3. Drive:

a. Drive frame and panel assemblies shall be galvanized steel. Drive frames shall be formed channels and fan panels shall have a deep formed inlet Venturi.

b. Pulleys shall be fully machined cast iron, keyed, and securely attached to propeller and motor shafts.

c. Motor sheaves shall be adjustable for system balancing.

4. Accessories:

a. Fans shall be provided with 12-in. high insulated prefabricated heavy gauge aluminum roof curb with liner and nailer, dampers and damper access section.

G. Roof Mounted Axial Type Exhaust Fan:

1. General:

a. Roof mounted axial type exhaust fan shall be of spark resistant construction.

2. Construction:

a. Housing:

1) Fans shall be constructed of low carbon steel and painted with corrosion resistant coating.

2) Housings shall be constructed of heavy gauge steel, structurally reinforced and suitably braced to prevent vibration or pulsation, and shall be arc welded throughout.

3) Lifting lugs shall be welded to the housing to facilitate handling of the fans.

4) Straightening vanes shall be supplied on vane axial fans to convert the helical airflow pattern to a smooth straight flow as it leaves the wheel to improve pressure characteristics and eliminate resonant noise.

b. Wheel:

1) Wheels shall be die-formed cast aluminum type.

2) Shaf Wheels shall be dynamically balanced, individually to ANSI S2.19, G6.3.

c. Shaft:

1) Shafts shall be AISI C1045 hot rolled steel turned, ground and polished. The shaft's first critical speed shall be at least 140% of the fan's maximum operating speed.

3. Accessories:

a. The accessories shall include, but not be limited to:

1) Belt guard.

2) Weather cover.

3) Quick open access door.

4) Drain.

5) Companion flanges.

6) Inlet screen.

7) Discharge screen.

8) Shaft seal.

9) Discharge cap.

10) Curb cap.

11) Vibration isolators.

H. In-Line Centrifugal Stainless Steel Fans:

1. General:

a. Fans shall have companion angle rings for inlet and outlet ductwork.

b. Fan wheels shall be type BAF air foil.

2. Construction:

a. Housing:

1) The fan housing shall be minimum 10 ga., commercial quality Type 316 stainless steel suitable for temperatures up to 200°F.

2) The inner housing shall be totally enclosed to protect the fan bearings and belts.

3) The inner housing shall be supported to the outer housing by means of air straightening guide vanes.

4) The housing and the wheels shall be continuously welded in compliance with ASME standards.

5) All accessories exterior to the air stream shall be epoxy coated (i.e., motor base and belt guard).

b. Wheel:

1) industrial quality Type 316 stainless steel blades having non-overloading horsepower characteristics.

2) The wheels shall be mounted to the fan shaft with a split taper bushing.

c. Shaft:

1) The shafts shall be ground and polished.

d. Bearings:

1) Fan bearings shall be grease lubricated with external fittings.

2) The fan bearings shall be heavy-duty, self-aligning ball or roller type depending on the fan size, motor horsepower, and performance, and relubricable for continuous service.

e. Motor Base:

1) The motor shall be mounted on a continuously welded motor base that is perpendicular to the fan housing, supported by four (4) adjustable riser bolt assemblies.

3. Drive:

a. The belts shall be oil, heat and static resistant type oversized for continuous duty.

b. Variable pitch drives shall be provided as standard up to and including fans with 10 hp motors.

4. Accessories:

a. Fans shall be complete with suspension clips or support legs as required, companion flanges and spring type vibration isolators.

I. Roof Mounted Centrifugal Exhaust Fans:

1. General:

a. Roof mounted centrifugal exhaust fans shall be of the centrifugal backward inclined type.

2. Construction:

a. Housing:

1) The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure.

2) The fan shroud shall have a rolled bead for added strength.

b. Wheel:

1) Fan wheel shall be constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

2) Wheels shall be statically and dynamically balanced.

c. Shaft:

1) Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.

3. Drive:

a. Motors shall be heavy duty ball bearing type.

b. Motors and drives shall be mounted on vibration isolators, out of the airstream.

c. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants.

d. Motors shall be readily accessible for maintenance.

e. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

f. Pulleys shall be of the fully machined cast iron type, keyed, and securely attached to the wheel and motor shafts.

g. Motor pulleys shall be adjustable for final system balancing.

4. Accessories:

a. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.

b. Fans shall be provided with 12-in. high insulated prefabricated heavy gauge aluminum roof curb, dampers and damper access section.

J. Tube Axial Upblast Roof Exhaust Fan:

1. General:

a. Roof mounted upblast exhaust fans shall be of the tube axial type.

2. Construction:
    a. Housing:
        1) Fan housings shall be constructed of welded heavy gauge steel to assure no air leakage.
    b. Propeller:
        1) Propeller construction shall be cast aluminum airfoil.
        2) Propellers shall be statically and dynamically balanced.
    c. Shaft:
        1) A standard square key or tapered bushing shall lock the propeller to the shaft.
3. Bearings:
    a. Bearing supports shall be constructed of structural steel members to prevent vibration and rigidly support the shaft and bearings.
    b. Close tolerances shall be maintained where the shaft makes contact with the bearing.
    c. Bearings shall be heavy duty, grease lubricated, self-aligning ball type in pillow block mounts.
    d. Extended lubrication lines shall be provided with external grease fittings.
4. Coatings:
    a. All structural steel parts shall be coated with corrosion resistant to provide a lasting finish.
5. Accessories:
    a. Wind bands shall be constructed of heavy gauge steel with reinforced edges.
    b. Curb caps shall be constructed of heavy gauge steel with a pre-punched mounting flange and integral Venturi inlet.
    c. Fans shall be provided with 12-in. high insulated prefabricated heavy gauge aluminum roof curb, dampers, and damper access section.

K. Tubular Centrifugal Inline Duct Fans:
1. General:
    a. Fan shall be a factory assembled and tested unit, complete with fan wheel, fan shaft, bearings, drive, motor, and accessories.

b. Tubular centrifugal inline duct fans shall have straightening vanes, flanged inlet and outlet connections, and support brackets for mounting.

c. Fan wheel shall be air foil design, non-overloading, statically and dynamically balanced, and shall have Venturi-shaped intake rim.

d. Lubrication may be oil or grease type.

2. Materials and Construction:

a. Tubular centrifugal inline duct fans shall be of aluminum construction.

b. Inner tube construction shall be welded to housing, with an access plate for servicing and the isolation of bearings and the drive from the air stream.

c. Adjustable pitch motor pulleys (if applicable): cast steel.

3. Drive:

a. Motors shall be ball bearing drive, and mounted on an adjustable platform outside the air stream.

b. If a v-belt drive is provided, it shall be provided with adjustable pitch motor pulleys.

4. Controls:

a. Integral overload protection, factory mounted and wired unfused disconnects shall be provided for all single-phase motors.

5. Coatings:

a. Refer to Section 09 91 00 – Painting.

b. The entire fan housing, blades, and all accessories shall be coated with minimum 3 coats (5 mil DFT) of the coating manufacturer specified for tubular centrifugal inline duct fans.

6. Accessories:

a. Hinged access doors,

b. Inlet and outlet flanges,

L. Wall Mounted Propeller Fans:

1. General:

a. Propellers shall be airfoil design, statically and dynamically balanced, and consist of six (6) blades.

2. Materials and Construction:

a. Propellers shall be of cast aluminum alloy or heavy gauge steel material.

b. Propellers shall be equipped with malleable iron split-taper bushing for alignment and locking of propeller to the shaft.

1) Bushing held in place by compression and keyed to the shaft to prevent slipping or loosening.

2) Positioned with three (3) standard cap screws for easy assembly and disassembly.

c. Venturi and panel shall be of heavy gauge steel and designed for airfoil propellers.

d. Mounting hardware shall be steel.

e. The Contractor to provide additional stiffeners, angles, and supports as required to mount the fans.

3. Drive:

a. Safety Guard shall have removable sections to provide for easy access to motor.

4. Coating:

a. All external and internal metal surfaces of fans, guards, (except propellers and motors) shall be factory primed and factory painted in accordance with Section 09 91 00 – Painting.

b. Propellers shall be factory coated with a four coat baked phenolic coating system minimum of two to three mils dry film thickness total.

c. All structural steel used for mounting fans shall be corrosion resistant coated.

M. Fiberglass Axial Roof Fans:

1. General:

a. Provide roof mounted, axial fan, with stack cap, butterfly gravity damper and curb base.

1) Curb shall be furnished by the fiberglass axial roof fan manufacturer.

2. Materials and Construction:

a. Housing:

1) Shall be manufactured of polyester resin reinforced with cloth and mat with integral flanges.

2) The bearing, base and drive enclosure shall be supported by gussets interlocked into and taped to the outer housing. These structural parts shall all be of laminated glass and resin.

3) All parts in contact with the air stream shall be constructed of solid FRP using fire retardant resin.

b. Wheel:

1) Shall be constructed using a hand lay-up method.

2) Glass cloth shall be cut to various template sizes to form laminations which are to be fitted into a mold.

3) Glass shall be impregnated with resin in a step-by-step process.

4) The fan wheel shall be cured under pressure in the mold forming a monolithic structure.

c. Shaft:

1) Shall be of Type 316 stainless steel.

2) Shall be Machined and keyed with the end drilled and tapped.

3) The wheel shall be held tightly against the shaft shoulder by a stainless steel bolt in the end of the shaft.

4) Type 316 stainless steel set screws shall be used to hold the key in place.

d. Shaft Seal:

1) The ends of the bearing and shaft enclosure shall have cover plates sealed into place with an inert silicone rubber sealant.

2) The propeller end cover plate shall be fitted with Viton or butyl shaft seal and stainless steel retainer plate.

e. Bearings:

1) The bearings shall be sealed pillow block type with grease tubes extending to the outside of the fan housing.

2) The bearings, shaft and drive shall be enclosed to protect them from air stream contaminants.

f. Motor Base:

1) A steel motor base with slide rail arrangement for belt adjustment shall be bolted between wide gussets integral with flanges of the fan housing.

g. Prefabricated Roof Curb:

1) Shall be weatherproof (slope base type for fans located on sloped roof) continuous welded aluminum construction.

2) Shall be insulated with 1½-in. minimum rigid board fiberglass.

3) Provide treated wood nailer on top of curb with gasket.

4) 12-in. curb height measured from finished roof to top of wood nailer on high side of roof slope or flat roof.

5) Curb to Roof Deck Fasteners: Cadmium plated lag screws or cadmium plated bolts.

3. Coatings:

a. Exterior housing of fan and all accessories shall be factory primed and painted in accordance with Section 09 91 00 – Painting.

1) Exterior surfaces of the FRP fan, shall be factory painted with an epoxy enamel finish.

2) Provide a primer coat and finish coat.

3) Paint shall be factory applied with touch-up painting in the field as required.

4. Accessories:

a. Provide bolts and nuts of Type 316 Stainless Steel.

b. Provide FRP curb base.

c. Provide FRP stack cap.

N. Fiberglass Inline Axial Flow Duct Fans:

1. General:

a. Housing:

1) Fiberglass inline axial flow duct fans shall be of solid FRP construction

2) Provide flanged inlet and outlet connections with bolt holes. Provide Viton or butyl Gaskets (minimum ¼-in. thick) at flexible connections to fan inlet and outlet.

b. Wheel:

1) Single piece solid fiberglass wheel, with a minimum of six (6) blades.

2) Wheel shall be statically and dynamically balanced.

c. Shaft:

1) Type 316 stainless steel shaft with EPDM slinger, Viton or butyl rubber seal and fiberglass cover plate.

2) Provide type 316 stainless steel hardware.

d. Bearings:

1) Greaseable ball bearings, external grease fittings, L-10 minimum life rating of 40,000 hours at maximum rated rpm.

e. Motor Base:

1) Motor mounted on fan housing, adjustable mounting. Drive compartment sealed off securely from any leakage of corrosive fumes.

2. Coatings:

a. Metal components shall be coated with corrosion proof paint as per Section 09 91 00 – Painting.

3. Accessories:

a. Steel mounting feet with a corrosion-resistant coating.

b. Access Doors:

1) Conform to housing curvature.

2) Gasketed (Viton or butyl).

4. Mounting Supports:

a. Provide Type 316 stainless steel support brackets and hardware for fan mounting.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Anchorage Devices:

1. Provide anchorage devices in accordance with Section 05 05 23.02 – Miscellaneous Metal Fastenings.

2. Contractor shall furnish anchor bolts and nuts of Type 316 stainless steel, of ample size and strength for the purpose intended, sized by the equipment manufacturer.

3. All hardware for mounting of motor drives and control panels shall be Type 316 stainless steel.

B. Identification:

1. Provide in accordance with Section 40 05 97 – Identification for Process Equipment.

2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

C. Dampers:

1. All dampers for roof mounted fans shall be mounted in the mounting pedestal with removable access panel for inspection and servicing of damper and operator.

2. Mounting pedestal shall provide solid ventilator support and a weather tight seal.

D. Balancing:

1. All fans shall be statically and dynamically balanced at the speed at which the unit is scheduled to operate. Fans with corrosion resistant coatings shall be balanced after being coated.

E. Coatings:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 – Painting.

2. If no other coating is otherwise specified for a type of fan on the HVAC Fan Schedule shown on the Contract Drawings, fans shall be provided (inside and outside) with baked on phenolic corrosion resistant coating including all accessories but not limited to the housing, wheels, curbs, liners, dampers, damper access sections. Coating shall be applied in the shop using the manufacturer's approved system.

3. Motors shall be painted in accordance with either Section 26 05 91 – Low-Voltage Electric.

4. Coat machined, polished, and non-ferrous metal surfaces and similar un-painted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All HVAC Fans shall be as efficient as those HVAC Fans that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.

2. The licensed Professional Engineer shall sign and seal all shop test reports.

a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.

2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install HVAC fans in complete accordance with the manufacturer's printed installation instructions and the approved Shop Drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall verify that all Work furnished and installed conforms to the requirements the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

3. Motor tests shall be performed in accordance with Section 26 05 91 – Low-Voltage Electrical Motors.

4. Perform field tests in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the HVAC fans in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.

2. The Contractor shall include instruction on care and maintenance of the HVAC fans in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all HVAC fans for their intended use.

a. Assembled fans shall then be dynamically balanced using a vibration analyzer to measure velocity.

b. The final reading shall not exceed 0.1-in./sec at the fan shaft speed.

c. The exact level of vibration will be recorded on the fan as proof of the final dynamic balance.

B. Protection:

1. The HVAC fans shall be protected as per the requirements of the Contract Documents. The use of HVAC fans shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each HVAC fan to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed HVAC fans and remove all debris and waste materials resulting from installation.

END OF SECTION

SECTION 23 37 00 – AIR OUTLETS AND INLETS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test intake and relief vents, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

C. All air outlet and inlets shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Not Used

1.05 DESCRIPTION

A. This Section includes requirements for providing air outlets and inlets as well as accessories in accordance with applicable standards and regulations. In addition:

1. Air outlets and inlets shall be furnished completely with all accessories, special tools, spare parts, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and Ordinances:
   a. Building Code of the City of New York.
   b. New York State Uniform Fire Prevention and Building Code.
   c. New York State Energy Conservation Construction Code.

B. Qualifications of Manufacturer:

1. All components of the air outlets and inlets shall be provided by the Contractor through a single air outlet and inlet vendor.
   a. The vendor shall engage manufacturer(s) which can show successful experience in the fabrication and manufacture of the equipment specified herein.
      1) The manufacturer(s) shall (each) have at least five (5) years' experience in the installation of Work specified.
   b. The Contractor (through the air outlet and inlet vendor), shall have the sole responsibility of matching all components and providing equipment which functions together as a system.
2. The air outlets and inlets shall be the standard equipment of the manufacturer(s).

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited, to:

1. Action Submittals:

a. Manufacturer's literature, illustrations, specifications, and Engineering data including:

1) Dimensions.

2) Materials of construction.

3) Details of installation.

4) Prefabricated curb details.

5) Air velocity through throat (fpm).

6) Air pressure drop through unit (in. W.G.).

b. Drawings showing:

1) The general arrangement of the equipment and methods of installation with detailed mounting information.

c. Documentation from the factory substantiating painting systems in accordance with the specifications. Include types applied and dry film thicknesses. Include color chart for color selection.

d. Operation and maintenance manuals

2. Information Submittals:

a. Spare parts list

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the air outlets and inlets for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The air outlets and inlets shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The air outlets and inlets shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, and as per the requirements of the Contract Documents and/or as recommended by the manufacturer.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All products provided under this Section shall be covered by a one (1) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Air outlets and inlets:

1. Multitier Louver Type TR (intake vent) and Type TRE (relief vent), as manufactured by Loren Cook Company, Powder Springs GA;
2. Greenheck Fan Corporation, Valley Forge, PA;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Air Intake and Relief Vents:

1. Capacity: As shown on the Contract Drawings.
2. General:
   a. Provide low contour, rectangular or square hood type, as shown on the Contract Drawings.
   b. Provide multitier louver type as shown on the Contract Drawings.
3. Construction:
   a. Housing:
      1) Spun aluminum construction reinforced to withstand wind forces without damage.
      2) Housings for intake and relief units shall be of similar in finish and color to match roof mounted fans in appearance.
   b. Base:
      1) One-piece spun aluminum or welded aluminum construction.

B. Accessories:

1. Dampers: Opposed-blade, aluminum construction. Dampers shall be Motor Operated Or Gravity Operated as shown on the Contract Drawings.
2. Bird Screen: ½-in. (13 mm) mesh Type 316 stainless steel screen securely anchored to housing at air outlet. Provide type 316 insect screen where shown on the Contract Drawings.
3. Curb Gasket: Self-adhesive gasket of Buna-N, EPDM, or Hypalon cemented to inner edge of curb to provide air and water seal between curb and housing.
4. Base to Curb Fasteners: Type 316 stainless steel lag screws and bolts.
5. Prefabricated Roof Curb:
    a. Weatherproof, continuous welded minimum 14 ga. aluminum construction.
    b. Insulated with 2-in. minimum fiberglass sandwiched between inner and outer walls of curb.
    c. 45° canted type sides.
    d. Provide curb with gasket as per above and wood blocking to mount curb. Provide flashing and counter flashing at curb as required to make watertight installation.
    e. 12-in. minimum curb height measured from finished roof to top of pressure treated wood nailer.
    f. Curb to Roof Deck Fasteners: Type 316 stainless steel lag screws and bolts.
    g. Refer to architectural Contract Drawings for curb flashing details.
    h. Contractor shall furnish prefabricated roof curbs from the same manufacturer as the air intakes and relief vents.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting:

1. All exterior and interior surfaces of equipment, including all accessories, shall be coated with a dry phenolic coating system.
    a. Finish and color to match housing.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.
    a. Only minor repair work will be permitted in the field.
    b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement

B. Examine curbs to receive air intake and relief vents for:
1. Horizontal mounting surface.
2. Water tightness.
3. Proper anchoring and flashing of prefabricated curb to roof deck.
4. Unevenness, irregularities, and incorrect dimensions that would affect quality and execution of installation.

C. Do not proceed with installation of air intake and relief vents until curbs conform to Contract requirements.

3.02 INSTALLATION

A. Roof openings and penetrations shall be capped to prevent weather from entering building prior to installation of air intakes or relief vents.

B. Install air outlets and inlets in complete accordance with manufacturer's printed installation instructions and the approved shop drawings.

C. Anchor base to wood nailer on curb with lag screws or bolts in manner that allows for easy removal for damper service.

D. Check proper connections for electrical wiring hook-ups for motorized dampers.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation, in accordance with the requirements of the Contract documents. In addition:
1. The Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:
1. Upon completion of the installation, the Contractor shall adjust all air intake and relief vents for their intended use.

B. Protection:

1. The air outlets and inlets shall be protected as per the requirements of the Contract Documents. The use of the air outlets and inlets shall not be permitted until permission is given by the Engineer.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly remove all debris and waste materials resulting from installation.
2. Clean tar, dirt, and marks from exterior of units.
3. Touch up all chips in factory finishes.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 23 62 26 – PACKAGED VARIABLE-REFRIGERANT-FLOW AIR-CONDITIONING SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all HVAC Variable Refrigerant Flow Heat Pumps, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

C. All HVAC Variable Refrigerant Flow Heat Pumps shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

B. Section 10 14 01 – Identifying Devices

C. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

D. Section 26 05 91 – Low-Voltage Electric Motors

E. Section 40 05 96 – Vibration and Seismic Controls

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	AHRI	Air Conditioning, Heating and Refrigeration Institute
2.	AHSRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
3.	ASME	American Society of Mechanical Engineers
4.	ASTM	American Society For Testing and Materials International
5.	NFPA	National Fire Protection Association
6.	UL	Underwriters Laboratories

B. Reference Standards:

1.	AHRI 210/240	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
2.	AHRI 270	Sound Rating of Outdoor Unitary Equipment
3.	AHRI 340/360	Standard for Commercial and Industrial Unitary Air-Conditioning Equipment and Heat Pump Equipment
4.	ASHRAE 15	Safety Standard for Refrigeration Systems
5.	ASHRAE 34	Designation and Safety Classification of Refrigerants
6.	ASME B31.5	Refrigeration Piping and Heat Transfer Components
7.	ASTM D1654	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
8.	NFPA 90A	Installation of Air Conditioning and Ventilating Systems
9.	UL 1995	Heating and Cooling Equipment
10.	UL 508	UL Standard for Safety Industrial Control Equipment

1.05 DESCRIPTION

A. This Section includes requirements for providing HVAC Variable Refrigerant Flow Heat Pumps and accessories in accordance with applicable standards and regulations. In addition:

1. HVAC Variable Refrigerant Flow Heat Pumps shall be furnished completely with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances
    a. Building Code of the City of New York.
    b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. All components of the HVAC Variable Refrigerant Flow Heat Pumps shall be provided by the Contractor through a single HVAC Variable Refrigerant Flow Heat Pumps vendor.
    a. The Contractor (through the HVAC Variable Refrigerant Flow Heat Pumps vendor) shall have the sole responsibility of matching all components and providing equipment which functions together as a system.
2. The HVAC Variable Refrigerant Flow Heat Pumps shall be standard equipment of the manufacturer.
3. The HVAC Variable Refrigerant Flow Heat Pumps shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.
4. All Variable Refrigerant Flow Heat Pumps shall be selected from performance data and not from rating tables.
5. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

b. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

c. Fan performance curve indicating the operating point.

d. Details of corrosion resistance coating.

e. Weights of assembled units.

f. Motor nameplate data as specified in Section 26 05 91 - Low-Voltage Electric Motors.

g. Specification Sections and data sheets for all accessories.

h. Example equipment nameplate data sheet.

i. Schematic diagrams for electric and control systems showing wiring for individual equipment items and interconnecting wiring diagrams.

j. Shop and field testing procedures.

k. Deviations from the Contract Documents.

l. Wiring diagrams with numbered terminal blocks for all external connections.

m. Description of control system.

n. Motor Tests and Data: For each motor submit a certified motor test data sheet or a certified motor data sheet from an electrically duplicate motor, in accordance with Section 26 05 91 - Low-Voltage Electric Motors.

o. Operation and maintenance manuals

p. Fan manufacturer shall provide sound power ratings in the eight octave bands.

1) Sound power levels shall be based on AMCA Standard 301.

2) Sound power ratings shall be in decibels, referenced to 10^{-12} W.

2. Information Submittals:

a. Spare Parts List

b. Special Tools List

c. Reports of Certified Shop Tests

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the HVAC Variable Refrigerant Flow Heat Pumps for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The HVAC Variable Refrigerant Flow Outdoor Heat Pumps shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The HVAC Variable Refrigerant Flow Outdoor Heat Pumps shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

1. Provide the following spare parts for up to every four (4) of the same size, model, and type of HVAC Variable Refrigerant Flow Outdoor Heat Pumps furnished under this Section:

2. Provide electric motor spare parts in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All equipment provided under this Section shall be covered by a two (2) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Variable Refrigerant Flow Outdoor Heat Pump

1. YORK, Milwaukee, WI
2. TRANE Technologies Davidson, NC
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Packaged Variable-Refrigerant-Flow Air-Conditioning Unit

1. System Description:

a. The variable capacity air-source heat pump system shall be submitted manufacturers or approved equal. The system shall be of split system design with enhanced heating capacity at low ambient air temperatures.

b. The system shall consist of an outdoor unit, multiple indoor units, and Direct Digital Controls (DDC) furnished by the heat pump system manufacturer. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.

c. All units shall be listed by nationally recognized testing laboratories.

2. General:

a. Outdoor units shall be used in a system made up specifically with manufacturer-approved components. Outdoor units shall be equipped with multiple circuit boards that interface to the factory controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired, and run tested at the factory.

b. All units requiring a factory supplied twinning kit shall be piped together in the field, without the need for equalizing line(s).

c. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.

d. Outdoor unit shall have a sound rating no higher than 60 dB(A) down to minus (-) six degrees Fahrenheit ambient temperature. At minus (-) five degrees Fahrenheit ambient temperature or less, the outdoor unit shall have a sound rating no higher than 65 dB(A).

e. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.

f. The outdoor unit shall have a high pressure safety switch, over-current protection, and DC bus protection.

g. The outdoor unit shall have the ability to operate with a maximum height difference of 160 feet or more and have a total refrigerant tubing length of 980 feet or more. The greatest length shall not to exceed 490 feet between the outdoor unit and the indoor units without the need for line size changes or traps.

h. The outdoor unit shall be capable of operating in heating mode down to minus (-) 13 degrees Fahrenheit wet bulb (WB) ambient temperature without additional low ambient controls. The unit shall maintain 100% heat output at five degrees Fahrenheit wet bulb (WB) ambient temperature without a supplemental heat source.

i. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

3. Construction:

a. Heat Interchanger Circuit:

(1) The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode.

(2) The interchanger shall be of tube within a tube design constructed of copper or aluminum.

(3) The interchanger circuit refrigerant flow shall be controlled by an electronic expansion valve.

b. Fan:

(1) Units shall be furnished with one direct drive, inverter driven, variable speed propeller type fan arranged for vertical discharge airflow pattern.

(2) The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

(3) The fan motor shall be mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts.

c. Coil:

(1) The outdoor coil shall be of nonferrous metal construction with lanced or corrugated plate fins on copper or aluminum tubing.

(2) The coil fins shall have a factory applied corrosion resistant finish.

(3) The coil shall be protected with an integral metal guard.

d. Compressor:

(1) Outdoor units shall be equipped with inverter driven scroll hermetic compressor(s) only. Non inverter-driven compressors shall not be allowed.

(2) All compressors shall have flash injection for effective low outdoor temperature heating performance. A crankcase heater(s) shall be factory mounted on the compressor(s).

(3) Each compressor shall be capable of modulation down to 16% of rated capacity.

(4) Compressors shall be equipped with internal thermal overload and shall be mounted to avoid the transmission of vibration.

e. Electrical:

(1) The outdoor unit electrical power characteristics shall be as indicated.

(2) The outdoor unit shall be controlled by integral microprocessors.

(3) The control circuit between the indoor units and the outdoor unit shall be 24 VDC completed using a 2-conductor, twisted pair non-polar shielded cable to provide total integration of the system.

a. Vibration isolators:

1) All vibration isolators shall be provided in conformance with the requirements of Section 40 05 96 - Vibration and Seismic Controls.

2) Isolators shall have a minimum efficiency of 90%.

3) Installation, type, number, and size of vibration isolators shall be in conformance with the manufacturer's recommendations for the frequencies involved.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Identification:

B. Provide in accordance with Section 10 14 01 - Identifying Devices.

1. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

2. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

C. Balancing:

1. All Variable Refrigerant Flow Heat Pumps fans shall be statically and dynamically balanced at the speed at which the unit is scheduled to operate. Fans with corrosion resistant coatings shall be balanced after being coated.

D. Coatings:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 - Painting.

2. If no other coating is otherwise specified for a type of Variable Refrigerant Flow Heat Pumps on the HVAC Variable Refrigerant Flow Heat Pumps Schedule shown on the Contract Drawings, fans shall be provided (inside and outside) with baked on phenolic corrosion resistant coating including all accessories but not limited to the housing, wheels, curbs, liners, dampers, damper access sections. Coating shall be applied in the shop using the manufacturer's approved system.

3. Motors shall be painted in accordance with either Section 26 05 91 – Low-Voltage Electric.

4. Coat machined, polished, and non-ferrous metal surfaces and similar un-painted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All HVAC Variable Refrigerant Flow Heat Pumps shall be as efficient as those HVAC Variable Refrigerant Flow Heat Pumps that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.

2. The licensed Professional Engineer shall sign and seal all shop test reports.

   a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

3. Refrigeration Systems Tests:

   a. Refrigerant Leakage Test

      1) After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a refrigerant leakage test. The refrigerant leakage test shall be done with dry nitrogen before any refrigerant pipe is insulated or covered. High and low side of the refrigerant system shall be tested for the minimum refrigerant leakage test pressure specified in ASHRAE 15, for the refrigerant employed in the system. System shall be proved tight and free of leaks by allowing the refrigerant leakage test pressure to remain on the system for 24 hours with no drop in pressure. The initial test pressure and surrounding air temperature will be recorded. After the 24 hour hold period, the final system pressure and surrounding air temperature will be recorded. A correction of 0.3 psi shall be allowed for each degree Fahrenheit change in the initial and final temperature of the surrounding air, plus for an increase and minus for a decrease. The system shall have passed the refrigerant leakage test if the corrected final system pressure is equal to the initial system test pressure. If the pressures are not equal, the leaks shall be located and repaired.

   b. Refrigerant Leaks:

      1) To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking or remelting and adding more brazing material will not be acceptable. After leak repairs have been made, the refrigerant leakage test shall be conducted again.

   c. System Charging and Startup Test:

      1) Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire

system shall be tested for leaks. Fluorocarbon systems shall be tested with electronic leak detectors, and bubble leak detection, Big Blu or equal.

d. System Performance Tests:

1) After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by an accepted manufacturer's startup representative experienced in system startup and testing, at such times as directed. Tests shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made and tests shall be re-conducted to demonstrate that the entire system is functioning as specified.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.

2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install HVAC Variable Refrigerant Flow Heat Pumps in complete accordance with the manufacturer's printed installation instructions and the approved Shop Drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

3. Motor tests shall be performed in accordance with Section 26 05 91 – Low-Voltage Electrical Motors.

4. Perform field tests in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the HVAC Variable Refrigerant Flow Heat Pumps in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.

2. The Contractor shall include instruction on care and maintenance of the HVAC Variable Refrigerant Flow Heat Pumps in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all HVAC Variable Refrigerant Flow Heat Pumps for their intended uses.

a. Assembled Variable Refrigerant Flow Heat Pumps shall then be dynamically balanced using a vibration analyzer to measure velocity.

b. The final reading shall not exceed 0.1-in./sec at the fan shaft speed.

c. The exact level of vibration will be recorded on the fan as proof of the final dynamic balance.

B. Protection:

1. The HVAC Variable Refrigerant Flow Heat Pumps shall be protected as per the requirements of the Contract Documents. The use of HVAC Variable Refrigerant Flow Heat Pumps shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each HVAC Variable Refrigerant Flow Heat Pumps to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed HVAC Variable Refrigerant Flow Heat Pumps and remove all debris and waste materials resulting from installation.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 23 72 13 – HEAT-WHEEL AIR-TO-AIR ENERGY-RECOVERY EQUIPMENT
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all HVAC Energy Recovery Ventilators, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	9
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	10

C. All HVAC Energy Recovery Ventilators shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

B. Section 10 14 01 – Identifying Devices

C. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

D. Section 26 05 91 – Low-Voltage Electric Motors

E. Section 40 05 96 – Vibration and Seismic Controls

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	AHRI	Air Conditioning, Heating and Refrigeration Institute
2.	AMCA	Air Movement and Control Association International
3.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
4.	NFPA	National Fire Protection Association

B. Reference Standards:

1.	AHRI 340/360	Standard for Commercial and Industrial Unitary Air-Conditioning Equipment and Heat Pump Equipment
2.	AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
3.	AMCA 99	Standards Handbook
4.	AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
5.	AMCA 301	Methods for Calculating Fan Sound Ratings from Laboratory Test Data
6.	ASHRAE 15	Safety Standard for Refrigeration Systems
7.	ASHRAE 34	Designation and Safety Classifications of Refrigerants
8.	ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
9.	ASHRAE 84	Method of Testing Air to Air Heat/Energy Exchangers
10.	NFPA 90A	Installation of Air Conditioning and Ventilating Systems

1.05 DESCRIPTION

A. This Section includes requirements for providing HVAC Energy Recovery Ventilators and accessories in accordance with ASHRAE 90.1, ASHRAE 62.1 , UL 1995/CSA C22.2 No. 236. In addition: The energy recovery unit shall bear an ETL or UL label.

1. HVAC Energy Recovery Ventilators shall have Double-wall, foam-injected panels; minimum R-6 overall casing insulation. All exposed steel surfaces to receive a factory-applied powder-coat epoxy finish, 2.0 mil min., 1 000-hour salt-spray per ASTM B117.

2. HVAC Energy Recovery Ventilators shall be furnished complete with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.

2. National Fire Protection Association.

3. National Electrical Code.

4. Local and State Building Codes and ordinances

a. Building Code of the City of New York.

b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. All components of the HVAC Energy Recovery Ventilators shall be provided by the Contractor through a single HVAC Energy Recovery Ventilators vendor.

a. The Contractor (through the HVAC Energy Recovery Ventilators vendor) shall have the sole responsibility of matching all components and providing equipment which functions together as a system.

2. The HVAC Energy Recovery Ventilators shall be standard equipment of the manufacturer.

3. The HVAC Energy Recovery Ventilators shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.

4. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

b. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

c. Energy Recovery Ventilators performance curve indicating the operating point.

d. Details of corrosion resistance coating.

e. Weights of assembled units.

f. Motor nameplate data as specified in Section 26 05 91, Low-Voltage Electric Motors.

g. Specification Sections and data sheets for all accessories.

h. Example equipment nameplate data sheet.

i. Schematic diagrams for electric and control systems showing wiring for individual equipment items and interconnecting wiring diagrams.

j. Shop and field testing procedures.

k. Deviations from the Contract Documents.

l. Wiring diagrams with numbered terminal blocks for all external connections.

m. Description of control system.

n. Motor Tests and Data: For each motor submit a certified motor test data sheet or a certified motor data sheet from an electrically duplicate motor, in accordance with Section 26 05 91, Low-Voltage Electric Motors.

o. Operation and maintenance manuals

2. Information Submittals:

a. Spare Parts List

b. Special Tools List

c. Reports of Certified Shop Tests

d. AMCA approval for Fan Ratings

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the HVAC Energy Recovery Ventilators for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The HVAC Energy Recovery Ventilators shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The HVAC Energy Recovery Ventilators shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer.

1. Provide electric motor spare parts in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All equipment provided under this Section shall be covered by a two (2) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Heat Wheel Air to Air Energy Recovery Ventilator

1. YORK, Milwaukee, WI

2. TRANE Technologies Davidson, NC

Carrier

Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Unit shall be a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream. Device performance shall be according to ASHRAE 84.
2. Device shall deliver an energy transfer effectiveness of not less than 85 percent with cross-contamination not in excess of 0.1 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel.
3. Exchange media shall be chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Exhaust and supply streams shall be isolated by seals which are static, field adjustable, and replaceable.
4. Chain drive mechanisms shall be fitted with ratcheting torque limiter or slip-clutch protective device. Enclosure shall be fabricated from galvanized steel and shall include maintenance access provisions.
5. Recovery control and rotation failure provisions shall be as indicated on Contract Drawings.
6. Energy Recovery Ventilators shall be as shown on the Contract Drawings.
    a. The capacity of all HVAC Energy Recovery Ventilators shall be as shown on the Contract Drawings.
7. Each Energy Recovery Ventilator shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
8. Motors:
    a. Motors shall comply with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.
    b. Unless otherwise indicated, motors shall be of the totally enclosed premium efficiency fan cooled type.
    c. Motors shall not be selected for operation in the service factor range/zone. The maximum brake horsepower required at any point on the performance curve shall not exceed the rated horsepower of the motor.
9. Vibration isolators:

a. All vibration isolators shall be provided in conformance with the requirements of Section 40 05 96 – Vibration and Seismic Controls.

b. Isolators shall have a minimum efficiency of 90%.

c. Installation, type, number, and size of vibration isolators shall be in conformance with the manufacturer's recommendations for the frequencies involved.

B. Energy Recovery Ventilators

1. General:

a. Unit shall be heat air to air energy recovery ventilator

b. Type: shall be a Desiccant Rotary Wheel energy recovery unit

2. Construction:

a. Enclosure Material shall be galvanized steel.

3. Fans:

a. Supply and exhaust fan shall be totally enclosed fan coil

b. Controls of fans shall be as indicated in submitted HVAC control sequences pertaining to Energy Recovery Units in Contract Drawings

4. Filter:

a. Filter shall be MERV 8 as indicated on Contract Drawings

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the Project.

B. Services shall be provided for the satisfactory completion of installation, start-up, testing, and training for those equipment and systems described herein below. Provide services of factory-trained service engineer who is specifically trained on the specified type of equipment.

C. Upon completion of all Work, furnish, in duplicate, certificates of inspection from equipment manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating condition.

D. Identification:

1. Provide in accordance with Section 10 14 01 – Identifying Devices.

2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

E. Balancing:

1. All Energy Recovery ventilators shall be statically and dynamically balanced at the speed at which the unit is scheduled to operate. Energy Recovery Ventilators with corrosion resistant coatings shall be balanced after being coated.

F. Coatings:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 – Painting.

2. If no other coating is otherwise specified for a type of Energy Recovery Ventilator on the HVAC Energy Recovery Ventilator Schedule shown on the Contract Drawings, fans shall be provided (inside and outside) with baked on phenolic corrosion resistant coating including all accessories. Coating shall be applied in the shop using the manufacturer's approved system.

3. Motors shall be painted in accordance with either Section 26 05 91 – Low-Voltage Electric.

4. Coat machined, polished, and non-ferrous metal surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All HVAC Energy Recovery Ventilators shall be as efficient as those HVAC Energy Recovery Ventilators that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.

2. The licensed Professional Engineer shall sign and seal all shop test reports.

a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.
2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.
    a. Only minor repair work will be permitted in the field.
    b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install HVAC Energy Recovery Ventilators in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.
2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.
3. Motor tests shall be performed in accordance with Section 26 05 91 – Low-Voltage Electrical Motors.
4. Perform field tests in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the HVAC Energy Recovery Ventilators in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.
2. The Contractor shall include instruction on care and maintenance of the HVAC Energy Recovery Ventilators in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the Site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all HVAC Energy Recovery Ventilators for their intended use.

a. Assembled Energy Recovery Ventilators shall then be dynamically balanced using a vibration analyzer to measure velocity.

b. The exact level of vibration will be recorded on the Energy Recovery Ventilators as proof of the final dynamic balance.

B. Protection:

1. The HVAC Energy Recovery Ventilators shall be protected as per the requirements of the Contract Documents. The use of HVAC Energy Recovery Ventilators shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each HVAC Energy Recovery Ventilators to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed HVAC Energy Recovery Ventilators and remove all debris and waste materials resulting from installation.

END OF SECTION

SECTION 23 74 16 – PACKAGED ROOFTOP AIR-CONDITIONING UNITS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all HVAC Packaged Rooftop Air Conditioning Unit, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	11

C. All HVAC Packaged Rooftop Air Conditioning Unit shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

B. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

C. Section 26 05 91 – Low-Voltage Electric Motors

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	AHRI	Air Conditioning, Heating and Refrigeration Institute
2.	AMCA	Air Movement and Control Association International
3.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Eng
4.	ASTM	American Society For Testing and Materials International
5.	NFPA	National Fire Protection Association
6.	UL	Underwriters Laboratories

B. Reference Standards:

1.	AHRI 210/240	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
2.	AHRI 270	Sound Rating of Outdoor Unitary Equipment
3.	AHRI 340/360	Standard for Commercial and Industrial Unitary Air-Conditioning Equipment and Heat Pump Equipment
4.	AHRI 410	Forced Circulation Air Cooling and Air Heating Coils
5.	AHRI 430	Central-Station Air Handling Units
6.	AHRI ARI Guideline D	Application and Installation of Central Station Air Handling Units
7.	AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
8.	AMCA 99	Standards Handbook
9.	AMCA 300	Reverberant Room Methods for Sound Testing of Fans
10.	ASHRAE 68	Laboratory Method of Testing to Determine the Sound Power in a Duct
11.	ASTM D 1654	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
12.	NFPA 90A	Installation of Air Conditioning and Ventilating Systems

13.	UL 1995	Heating and Cooling Equipment
14.	UL 508	UL Standard for Safety Industrial Control Equipment
15.	UL 900	Air Filters Units

1.05 DESCRIPTION

A. This Section includes requirements for providing HVAC Packaged Rooftop Air Conditioning Unit and accessories in accordance with applicable standards and regulations. In addition:

1. HVAC Packaged Rooftop Air Conditioning Unit shall be furnished completely with all accessories, special tools, spare parts, base attachments, mountings, anchor bolts, and other appurtenances as specified and/or required for proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with the applicable provisions of the standards organizations and regulatory agencies, below:

1. Underwriters Laboratories, Inc.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and ordinances
    a. Building Code of the City of New York.
    b. New York State Uniform Fire Prevention and Building Code.

B. Qualifications of Manufacturer:

1. All components of the HVAC Packaged Rooftop Air Conditioning Unit shall be provided by the Contractor through a single HVAC Packaged Rooftop Air Conditioning Unit vendor.
    a. The Contractor (through the HVAC fan Packaged Rooftop Air Conditioning Unit) shall have the sole responsibility of matching all components and providing equipment which functions together as a system.
2. The HVAC Packaged Rooftop Air Conditioning Unit shall be standard equipment of the manufacturer.
3. The HVAC Packaged Rooftop Air Conditioning Unit shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.
4. Provide units listed by the Underwriters Laboratories, Inc.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

b. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

c. Details of corrosion resistance coating.

d. Weights of assembled units.

e. Motor nameplate data as specified in Section 26 05 91 – Low-Voltage Electric Motors.

f. Specification Sections and data sheets for all accessories.

g. Example equipment nameplate data sheet.

h. Schematic diagrams for electric and control systems showing wiring for individual equipment items and interconnecting wiring diagrams.

i. Shop and field testing procedures.

j. Deviations from the Contract Documents.

k. Wiring diagrams with numbered terminal blocks for all external connections.

l. Description of control system.

m. Motor Tests and Data: For each motor submit a certified motor test data sheet or a certified motor data sheet from an electrically duplicate motor, in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

n. Operation and maintenance manuals

o. Packaged Rooftop Air Conditioning Unit manufacturer shall provide sound power ratings in the eight octave bands.

1) Sound power levels shall be based on AMCA Standard 301.

2) Sound power ratings shall be in decibels, referenced to 10^{-12} W.

2. Information Submittals:

a. Spare Parts List

b. Special Tools List

c. Reports of Certified Shop Tests

d. AMCA Approval for equipment Ratings

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation, and packing of the HVAC Packaged Rooftop Air Conditioning Unit for shipment shall be in accordance with the manufacturer's commercial practice.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The HVAC Packaged Rooftop Air Conditioning Unit shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The HVAC Packaged Rooftop Air Conditioning Unit shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

1. Provide electric motor spare parts in accordance with Section 26 05 91 – Low Voltage Electric Motors.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All equipment provided under this Section shall be covered by a two (2) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Heat Wheel Air to Air Energy Recovery Ventilator

1. TRANE as manufactured by TRANE Manufacturing La Crosse, WI

2. TRANE Technologies Davidson, NC

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Units shall be Single Zone Variable Air Volume with dual compressors and a downflow configuration as indicated on contract drawings. Units shall include fans, coils, airtight insulated casing, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

1. Packaged Rooftop Air Conditioning Unit shall be as shown on the Contract Drawings.

a. The capacity of all HVAC Packaged Rooftop Air Conditioning Unit shall be as shown on the Contract Drawings.

2. Each Packaged Rooftop Air Conditioning Unit shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

3. Motors shall comply with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

B. Packaged Rooftop Air Conditioning Unit

1. Casings:

a. Casing sections shall be constructed of a minimum of 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish.

b. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit.

c. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18 gage outer and 20 gage inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high.

d. Each casing section handling conditioned air shall be insulated with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Factory applied fibrous glass insulation shall conform to ASTM C1071, except that the minimum thickness and density requirements do not apply and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors.

2. Drain Pan:

a. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage.

b. Intermediate drain pans or condensate collection channels and downspouts shall be provided, to carry condensate to the unit drain pan out of the air stream and without moisture carryover.

3. Heating and Cooling Coils

4. Air Filters:

a. Air filters shall be listed according to requirements of UL 900.

(1) The HVAC Subcontractor shall furnish a minimum of four additional complete sets of filters for all air handling equipment using filters. In addition to the filters furnished with each piece of equipment from the manufacturer, the HVAC Subcontractor shall provide two complete sets of filters to be used during the construction and then the testing and balancing period. Additionally, a complete new set of filters shall be installed after the testing and balancing period. Finally, a complete new set of filters shall be installed upon substantial completion of the Project, prior to final acceptance by the Owner's Representative.

5. Fans:

a. Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit.

b. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type.

c. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for

externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating.

d. Fans shall be selected to produce the required capacity at the fan static pressure.

6. Motor:

a. Motors for V-belt drives shall be provided with adjustable bases.

b. Motors shall have open drip proof enclosure.

7. Fan Bearings:

a. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11.

b. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing.

2.03 FABRICATION / ASSEMBLING / FINISHES

1. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the Project.

2. Services shall be provided for the satisfactory completion of installation, start-up, testing, and training for those equipment and systems described herein below. Provide services of factory-trained service engineer, specifically trained on type of equipment specified.

3. Upon completion of all Work, furnish, in duplicates, certificates of inspection from equipment manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found the same to be in satisfactory operating condition.

A. Identification:

1. Provide in accordance with Section 40 05 97 – Identification for Process Equipment.

2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's

name or trademark, and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

B. Dampers:

1. All dampers for Packaged Rooftop Air Conditioning Unit shall be mounted in the mounting pedestal with removable access panel for inspection and servicing of damper and operator.

2. Mounting pedestal shall provide solid ventilator support and a weather-tight seal.

C. Balancing:

1. All Packaged Rooftop Air Conditioning Units shall be statically and dynamically balanced at the speed at which the unit is scheduled to operate. Fans with corrosion resistant coatings shall be balanced after being coated.

D. Coatings:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 – Painting.

2. If no other coating is otherwise specified for a type of fan on the HVAC Packaged Rooftop Air Conditioning Unit Schedule shown on the Contract Drawings, fans shall be provided (inside and outside) with baked on phenolic corrosion resistant coating including all accessories but not limited to the housing, wheels, curbs, liners, dampers, damper access sections. Coating shall be applied in the shop using the manufacturer's approved system.

3. Motors shall be painted in accordance with either Section 26 05 91 – Low-Voltage Electric.

4. Coat machined, polished, and non-ferrous metal surfaces and similar un-painted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All HVAC Packaged Rooftop Air Conditioning Unit shall be as efficient as those HVAC Packaged Rooftop Air Conditioning Unit that have been tested to perform satisfactorily for at least two (2) years.

B. Shop Tests:

1. All shop tests shall be witnessed by a licensed Professional Engineer.

2. The licensed Professional Engineer shall sign and seal all shop test reports.

a. The state of the Professional Engineer's registration, the Professional Engineer's license number, and the Professional Engineer's name on the seal shall be clearly legible.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The inspection shall include welding, dimensions, bearings, and overall workmanship.

2. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install HVAC Packaged Rooftop Air Conditioning Unit in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Units shall be electrically grounded in the field by installing contractor.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract documents. In addition:

1. The Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

3. Motor tests shall be performed in accordance with Section 26 05 91 – Low-Voltage Electrical Motors.

4. Perform field tests in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the HVAC Packaged Rooftop Air Conditioning Unit in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.

2. The Contractor shall include instruction on care and maintenance of the HVAC Packaged Rooftop Air Conditioning Unit in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all HVAC Packaged Rooftop Air Conditioning Units for their intended use.

a. Assembled Packaged Rooftop Air Conditioning Unit fans shall then be dynamically balanced using a vibration analyzer to measure velocity.

b. The exact level of vibration will be recorded on the fan as proof of the final dynamic balance.

B. Protection:

1. The HVAC Packaged Rooftop Air Conditioning Unit shall be protected as per the requirements of the Contract Documents. The use of HVAC Packaged Rooftop Air Conditioning Unit shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each HVAC Packaged Rooftop Air Conditioning Unit to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed HVAC Packaged Rooftop Air Conditioning Unit and remove all debris and waste materials resulting from installation.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 23 83 33 – ELECTRIC RADIANT HEATERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all electric radiant heaters, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	15
2.04	Source Quality Control / Shop Tests	16
PART 3	EXECUTION	16
3.01	Examination / Preparation	16
3.02	Installation	16
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	17
3.05	Adjusting / Protection / Cleanup	17

C. All electric radiant heaters shall be provided in accordance with the schedule shown on the Contract Drawings.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

1.04 REFERENCES

A. Reference Standards:

1. UL Standard 1096 - Electrical Central Air Heating Equipment

1.05 DESCRIPTION

A. This Section includes requirements for providing electric radiant heaters and accessories in accordance with applicable standards and regulations. In addition:

1. Electric radiant heaters shall be furnished complete with all accessories, special tools, spare parts, attachments, mountings, anchor bolts, and other appurtenances as specified and/or as may be required for a proper installation.

1.06 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with applicable provisions of the standards organizations and regulatory agencies, below.

1. Underwriters Laboratories, Incorporated.
2. National Fire Protection Association.
3. National Electrical Code.
4. Local and State Building Codes and Ordinances.
    a. New York City Building Code.
    b. New York State Uniform Fire Prevention and Building Code.
    c. New York State Energy Conservation Construction Code.

B. Qualifications of Manufacturer:

1. All components of the electric radiant heaters shall be provided by the Contractor through a single electric radiant heater vendor.
    a. All electric radiant heaters included in the Work shall be one of a single manufacturer and of similar character in a location.
    b. The Contractor (through the electric radiant heater vendor) shall have the sole responsibility of matching all components and providing equipment which functions together as a system.
2. The electric radiant heaters shall be standard equipment of the manufacturer.
3. The electric radiant heaters shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.
4. Provide units listed by the Underwriters Laboratories, Inc.

C. Qualifications of Contractor:

1. The Contractor shall be a New York City licensed plumber.

2. The Contractor shall have at least five (5) years' experience in the installation of the Work specified.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited, to:

1. Action Submittals:

a. Manufacturer's literature, illustrations, specifications, and engineering data, including, but not limited to:

1) Dimensions.

2) Capacities.

3) Materials of construction.

4) Finishes, standard and custom color chart for Engineer's approval.

b. A complete wiring diagram shall be submitted indicating both factory and field connections.

c. Documentation from the factory substantiating painting systems in accordance with the Contract Documents. Include types applied and dry film thicknesses.

d. Deviations from the Contract Documents.

e. Operations and Maintenance Manuals.

2. Information Submittals:

a. Special Tools List.

b. Spare Parts List.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The cleaning, preservation and packing of the electric radiant heaters for shipment shall be in accordance with the manufacturer's commercial.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. The electric radiant heaters shall be handled in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

2. The electric radiant heaters shall be protected from corrosion and deterioration and shall be stored in a dry area.

a. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with effective and durable waterproof covers approved by the Engineer.

3. Interiors shall be kept free from dirt and foreign matter.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, and as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:

1. Provide one (1) can of touch up paint, one-quart size for each type of electric radiant heater.

2. Provide two (2) sets of spare filters for each cabinet style heater.

3. Provide one (1) motor for up to every four of same size motors for all heaters.

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. All products provided under this Section shall be covered by a one (1) year manufacturer warranty, which shall commence upon Substantial Completion, and shall cover 100% of the parts and labor involved in repair or replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Unit Heaters:

1. Electric Unit Heaters:

a. Model LUH, as manufactured by Chromalox, Trane Co., Long Island City, NY;

b. Or approved equal

2. Electric Unit Heaters (Explosion-Proof):

a. Series 236 Compact Explosion-proof unit heater, as manufactured by Industrial Engineering and Equipment Company (Indeeco), Saint Louis, MO;

b. Or approved equal.

3. Electric Unit Heaters (Corrosion Resistant):

a. Chromalox , Pittsburgh, PA;

b. Stelpro, Quebec, Canada;

c. Marley/Qmark, Bennettsville, SC;

d. Or approved equal.

4. Cabinet Unit Heaters:

a. Force Flo Cabinet Heater, as manufactured by Trane Company, Long Island, NY;

b. Marley/Qmark, Bennettsville, SC;

c. Stelpro, Quebec, Canada;

d. Or approved equal.

5. Wall Heater:

a. Marley/Qmark, Bennettsville, SC;

b. Stelpro, Quebec, Canada;

c. Indeeco, St. Louis, MO;

d. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. All electric radiant heaters shall be provided in accordance with the schedule shown on the Contract Drawings; capacity and electrical supply characteristics shall be as shown on the schedule.

2. Provide complete, factory-assembled, and wired units.

B. Unit Heaters:

1. Electric Unit Heaters:

a. Casing:

1) Shall be constructed of minimum 18 ga. steel.

2) Finished in high-gloss coating:

a) Each unit heater shall have a corrosion resistant coating.

b) The entire unit shall be coated internally and externally with a baked phenolic corrosion resistant coating.

3) Adjustable discharge louvers shall be provided to control the direction of air flow.

b. Heating Element:

1) High mass, all steel, tubular finned type.

c. Fan:

1) Axial flow type.

2) Statically and dynamically balanced at the speed at which the unit is scheduled to operate.

d. Motor:

1) Type: Single speed.

2) Enclosure: Totally enclosed.

3) Overload Protection: Internal thermal overload protection.

e. Contactors and Control Circuit Transformers:

1) Shall be factory installed and wired.

2) Two stage operation shall be provided on all units.

3) Each unit shall be complete with wall mounted thermostat and with hand-off-auto subbase.

4) Built in fan override shall be provided to purge unit casing of excess heat after unit shut down.

f. Accessories:

1) Each unit heater shall be provided with mounting brackets.

2. Electric Unit Heaters (Explosion-Proof):

a. Explosion-proof electric unit heaters shall be suitable for use in a National Electrical Code, Class 1, Division 1, Group D environment and NEC T-1. Factory Mutual approved.

b. Casings:

1) Shall be constructed of minimum 18 ga. Type 316 stainless steel shroud and cast iron terminal enclosure with bottom access cover.

c. Heating Element:

1) Type 316 stainless steel, finned tubular construction.

d. Fans:

1) Broad blade axial flow-type design.

2) Materials: Aluminum.

3) Statically and dynamically balanced at the speed at which the unit is scheduled to operate.

e. Motors:

1) Type: Single speed.

2) Enclosure: Totally enclosed-explosion-proof.

3) Mounting: resilient mounted.

4) Bearings: Permanently lubricated, sealed bearings.

5) Overload Protection: Integral overload protection.

6) Power: As shown on the Contract Drawings.

7) Produced in accordance with NEMA standards.

8) Factory wired to enclosure.

9) Suitable for 40°Celsius ambient temperature.

f. Air Deflectors:

1) Outlet grilles shall be louvered for 45° throw (adjustable), stainless steel.

g. Built-in controls:

1) Element terminals, thermal cutouts, manual reset cut out, controlling and back-up contactors and fan delay relay shall be housed in a NEMA 7 enclosure.

h. Explosion-Proof Room Thermostat:

1) UL Listed for Class I, Group D hazardous locations. Explosion proof Construction.

2) Complete with built-in thermometer.

3) 40°Fahrenheit to 100°Fahrenheit Range with 1°Fahrenheit differential.

4) Tamperproof set point locking device.

5) Rating: 120-volt AC, 125 VA rating.

i. Controls:

1) Explosion proof room thermostat, field wired to unit heater to control heater operation set at 55°Fahrenheit (adjustable) or as required.

j. Coatings:

1) Epoxy coat enclosure, fan blade, conduit, and fittings.

k. Accessories:

1) Each unit shall be provided with Type 316 stainless steel swivel bracket for wall mounting and stainless steel hardware.

3. Electric Unit Heaters (Corrosion Resistant):

a. Casing:

1) Shall be constructed of minimum 18 ga. steel.

b. Heating Element:

1) Monel fin tube heating elements attached to junction box with leak proof threaded fittings.

c. Fans:

1) Aluminum spark resistant construction.

d. Motor:

1) Enclosure: Totally enclosed

2) Bearings: Permanently lubricated ball bearings.

3) Overload Protection: Built-in. Moisture and corrosion resistant automatic reset.

e. Air Deflectors:

1) Adjustable louvered outlet grille, finish same as fan.

2) Heavy gauge rear wire grille, finish same as fan.

3) All hardware shall be stainless steel.

f. Built-in Controls:

1) Heating elements, motor and cutout to be factory prewired to junction terminal block for easy hook-up.

2) Furnish all controls (thermostat, relay, transformer etc.) for field installation as necessary for control operation.

3) Controls shall include:

4) Provide integral NEMA 4X molded fiberglass junction box for the following unit mounted controls:

a) Two (2) power contactors, primary and backup.

b) One (1) motor contactor.

c) One (1) over temperature protection.

d) One (1) thermal fan delay switch.

5) Provide transformer for 120 V control circuit.

g. Room Thermostat:

1) Heavy duty line voltage SPDT, 120V, single phase.

2) 40° to 100°Fahrenheit range with 1°Fahrenheit differential.

3) Weatherproof NEMA 4X, corrosion resistant construction.

4) Shielded sensing bulb.

5) Neoprene gasket to seal out dust and moisture.

6) Adjustable knob for temperature setting.

7) Positive off by setting unit to low position.

8) For each electric unit heater (corrosion resistant), provide either one (1) of the following, as shown on the Contract Drawings:

a) Wall-mounted, field installed

b) Unit-mounted, factory-installed

h. Coating:

1) All sheet metal parts shall be protected by zinc chromate primer and 2 coats of epoxy enamel, all factory painted in accordance with Section 09 91 00 – Painting.

i. Accessories:

1) Each unit shall be provided with Type 316 stainless steel swivel bracket for wall mounting bracket and stainless steel hardware.

4. Cabinet Unit Heaters:

a. Cabinet:

1) Front panel: 16 ga. steel.

2) Top and side panels: 18 ga. steel.

3) Finish: Phosphate treated, baked enamel.

b. Heating Elements:

1) Material: Open wire type, nichrone alloy element design.

2) Type: Resistance heat.

3) Electric Heating Coils:

a) Hydronic type finned-tube construction, with:

(1) For 200-600 cfm units: resistance elements inserted in tubes.

(2) For 800-1800 cfm units: spiral sheath type.

c. Fans:

1) Forward curved centrifugal, double width, double inlet type.

2) Material: Aluminum.

3) Mounting: Resilient on die-formed steel board.

d. Motor:

1) Type: 2-speed, shaded pole.

2) Mounting: Resilient mounted.

3) Bearings: Permanently lubricated.

4) Overload Protection: Provide integral overload protection and motor starter.

5) Extended motor oilers.

e. Filter:

1) 1-in. thick throw away type mounted in filter frame.

f. Controls:

1) Units factory wired with unit mounted single heat switch, magnetic contactors, high temperature cutout safety control, and fan override thermostat.

2) Motor switch (HEAT-OFF-VENT).

3) Unit-mounted transformer.

4) For each electric unit heater (corrosion resistant), provide either one (1) of the following types of thermostats, as shown on the Contract Drawings:

a) Wall-mounted, field installed

b) Unit-mounted, factory-installed

5. Wall Heater:

a. Type: Recessed mounted, down-flow, all internally wired automatic unit.

b. Wall Box:

1) Shall be constructed of 20 ga. steel

2) Coating: phosphatized and baked enamel finish.

c. Face Plate:

1) Ribbed 16-ga. minimum steel front cover.

2) Each unit shall have closely spaced, downflow discharge louvers.

3) Provide concealed screws for locking trim frame to front cover.

4) Finished in neutral gray baked enamel with satin finish anodized aluminum trim frame.

d. Heating Element:

1) Provide one (1) of the following types of heating elements:

a) Cast aluminum heating grid.

b) Metal sheathed heating element.

e. Fan:

1) Shall be of broad blade type.

2) Material: stamped metal.

3) Mounting: Bolted to motor shaft.

f. Thermostat:

1) Integrally mounted.

2) Built-in thermostat comfort control

3) 55°F to 85°F range with 1°F differential.

4) Manually set "No Heat" position.

5) Adjustment: Tamper-resistant, shall require inserting screwdriver through front cover louvers.

g. Motor:

1) Type: Single speed.

2) Enclosure: Totally enclosed.

3) Bearings: Permanently lubricated.

4) Overload Protection: Provide integral overload protection.

5) Produced, tested and rated in accordance with NEMA standards.

h. Built-in Controls:

1) Unit shall be all internally wired and automatic.

2) Automatic reset line voltage internal thermal overload protection.

3) Built-in fan delay switch.

4) Line power terminal blocks for field power wiring connections.

5) Fan and motor assembly statically and dynamically balanced.

6) Transformer: Built-in, if required.

i. Accessories:

1) Provide accessories for recessed mounting of wall heaters.

C. Electric Duct Heaters:

1. Frame:

a. Frame shall be constructed of minimum 16 heavy ga. stainless steel with stainless steel brackets, stiffening ribs and gussets spot welded to the casting.

b. Framing for duct heater shall be flanged for internally insulated duct, slip-in type if external insulation is used.

c. Duct heater frame shall be reinforced with needed corner bracing.

2. Insulation:

a. Insulation of fiberglass at least ½in. thick shall be used between duct heater and control box for maximum condensation protection.

3. Heating Element:

a. Heaters shall be constructed per U.L. standards for zero clearance and shall meet NEC requirements.

b. Heating elements shall be finned tubular Type 301 or 304 stainless steel with internal resistance wire of 80% nickel and 20% chromium; steps shall be arranged to prevent stratification when operating at less than full capacity.

c. Provide insulated element terminals.

d. Terminal box shall be spot welded construction with solid, hinged cover, totally enclosed, without louvers or grilles per UL Standard 1096. NEMA 4X stainless steel.

e. Three phase heaters shall be furnished with balanced phases on each step.

f. Elements shall be rated approximately 50 W/in.^{2} of wire surface area.

4. Controls:

a. Air flow sensing tube for air flow proving switch shall indicate direction of air flow and be field reversible without removing heater from duct.

b. Disc type automatic reset thermal protection shall be provided as the primary protection and shall be mounted on the duct heater directly in the air stream to provide positive, fast response.

c. Provide secondary manual limit-type reset thermal protection in control circuit in series with automatic.

5. Wiring Diagrams:

a. A wiring diagram shall be furnished for each type of heater. Diagram shall include recommended supply wire gauges in conformance to the NEC and fuse sizes. Typical wiring diagrams are not acceptable.

6. Duct Size: Shall be as indicated in the Electric Radiant Heater Schedule shown on the Contract Drawings.

7. Step Controller (three or more heating stages as scheduled):

a. Type: Electronic.

b. Steps: Shall be as shown on the Contract Drawings.

c. Input: 0 to 135 ohm.

d. Step controller shall cycle to zero load if a momentary power interruption occurs.

8. Thermostat:

a. Heavy duty line voltage SPDT, 120V, single phase.

b. 40° to 100°Fahrenheit range with 1°Fahrenheit differential.

c. Weatherproof NEMA 4X, corrosion resistant construction.

d. Shielded sensing bulb.

e. Neoprene gasket to seal out dust and moisture.

f. Adjustable knob for temperature setting.

g. Positive off by setting unit to low position.

h. Provide wall-mounted room thermostat for field wiring.

9. Pilot Lights: Built-in, factory wired, transformer coupled, 6V lamped pilot lights shall indicate the following conditions:

a. Heater Energized.

b. Step Energized: 1 per step.

c. When built-in-air flow switch opened.

10. Proof of Air Flow Switch:

a. Provide in accordance with UL Standard 1096.

b. Type: Pressure differential switch.

c. Shall deactivate unit and de-energize heating element if proper air flow is not present.

11. Built-in Options:

a. Non-mercury Control Contactors.

b. Main Power Disconnect Switch.

c. Interlock terminal strip for interlocking supply air fan.

d. Control Transformers with Fused Primaries for 120 vac and 24 vac circuits.

12. Unit Mounted Control Enclosure:

a. Standard control box shall be of the hinged, solid cover type, NEMA 4X (NEMA 7 in NFPA classified explosion proof area) stainless steel construction.

D. Convection/Radiation Heaters:

1. General:

   a. Provide wall-mounted electric, convection heaters, completely factory wired with integral thermostat.

      1) End caps and filler or blank sections shall be included.

2. Capacity: The convection/radiation heater shall be as indicated in the Electric Radiant Heater Schedule shown on the Contract Drawings.

3. Cabinet:

   a. Shall be constructed of 16 ga. steel enclosure with reinforced all welded construction.

   b. Top discharge to be an extruded aluminum bar grille with protective ¼-in. mesh screen below grille.

   c. Bottom air inlet perforated openings.

   d. Back surface of heater, filler and blank section enclosure to be completely smooth, except for electrical knockouts and mounting holes.

   e. Bottom of front cover fastened to back panel with concealed screws and top of front cover to engage with grille supports.

   f. Sleeve, end cap, and corner accessories to be internal telescoping type, mounted to concealed top and bottom sliding set screw fasteners in end of sill line heaters, filler, or blank sections, and finished in dark baked enamel.

   g. Back panel slotted along top and bottom for attachment to wall or window mullions without removal of heating assembly.

   h. Filler and blank section accessories to be of same cross-section as sill line heater enclosure, with butt-joint ends. 8-in. filler section to have hinged access door.

4. Coating:

   a. Enclosure shall be chemically treated to resist corrosion and finished in grey prime suitable for field finish, as per Section 09 91 00 – Painting. Provide a dark baked enamel finish.

5. Heating Element:

   a. Heating elements shall be aluminum.

   b. Elements shall be center anchored and shall float freely on each end through nylon bushings.

6. Controls:

a. Provide factory installed built-in controls shall include thermostat, power disconnect switch, transformer relay, etc. Wall mounted thermostat for field wiring where shown on the Contract Drawings.

b. An automatic reset thermal overheat protector with automatic reset shall run the full-length of the heater and shall turn off heating elements should overheating occur at any point along heating length.

7. Thermostat:

a. Thermostats shall be adjustable through discharge louvers.

E. Electric Baseboard Heaters:

1. General:

a. Provide electric baseboard heaters, complete with aluminum finned metal sheath heating elements, a built-in thermostat and an automatic reset thermal overheat cutout.

b. Electric baseboard heaters shall be complete with bottom inlet and top discharge grilles and shall be wall mounted as shown on the Drawings.

2. Capacity: The electric baseboard heater shall meet the minimum size, heating capacities and arrangement indicated on the Electric Radiant Heater schedule shown on the Contract Drawings.

3. Enclosure:

a. The enclosure shall be of heavy gauge steel with baked on enamel finish of a color selected from the manufacturer's color charts.

4. Controls:

a. The electrical components shall be factory prewired to a terminal strip.

b. All controls including thermostat shall be unit mounted and factory installed.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Identification:

1. Provide in accordance with Section 40 05 97 – Identification for Process Equipment.

2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. All electric radiant heaters shall be as efficient as those which have been tested to perform satisfactorily for at least two (2) years and providing equipment, which functions together as a system.

B. Electric Duct Heaters:

1. Heaters shall be electrically tested as follows:

a. For electric duct heaters rated ≤ 250 V: Test at 1,000 V.

b. For electric duct heaters rated > 250 V: Test at and 1,000 V plus twice the rated voltage.

2. All heaters shall be tested at manufacturing facilities for assurance of high-quality standards and performance by trained personnel.

3. All components shall be tested for function following installation in the heater.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

3.02 INSTALLATION

A. Install electric radiant heaters in complete accordance with the manufacturer's printed installation instructions and the approved Shop Drawings. In addition:

1. Install cabinets level and plumb.

2. Coordinate with ceiling grid for ceiling recessed units installation.

3. Set air deflectors for proper air delivery.

4. Check room thermostat and wiring connections to heater.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation in accordance with the requirements of the Contract documents. In addition:

1. The Contractor shall verify that all Work furnished and installed conforms to the requirements of the Contract Documents.

B. All tests shall be performed in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist and train the plant operations and maintenance staff in the care, operation, and maintenance of the electric radiant heaters in accordance with the requirements of the Contract Documents. In addition:

1. The Contractor shall make all adjustments required to place Work in proper operating condition.

2. The Contractor shall include instruction on care and maintenance of the electric radiant heaters in the training of plant personnel.

3. In the event of trouble with the equipment, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all the electric radiant heaters for their intended use.

B. Protection:

1. Electric radiant heaters shall be protected as per the requirements of the Contract Documents. The use of electric radiant heaters shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each electric radiant heater to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed electric radiant heaters and remove all debris and waste materials resulting from installation.

2. Clean work as specified in the Contract Documents.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 11 – GENERAL ELECTRICAL REQUIREMENTS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, and equipment required to perform the Work in accordance with the general electrical requirements as specified under this Section and shown on the Contract Drawings.

B. The Work shall also include the following:

1. Inserts and other electrical items which shall be installed embedded in concrete, or built into walls, partitions, ceilings, or panels constructed by Other Contractors.

2. Installation procedures and schedules under other contracts shall be reviewed and coordinated with Other Contractors regarding the installation of electrical items that must be installed.

3. Keep informed of the construction so the electrical work shall be installed within such time periods as will not delay the Work of the Other Contractors.

4. Notify Other Contractors in advance of the installation of the Work included, so they shall have sufficient time for coordination and installation of interrelated items that are included in their contracts and that must be installed in conjunction with the Work included under this Contract.

5. Electrical equipment demolition shall include demolition of all associated conduits and wiring, fittings, boxes, supports, and accessories.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5

PART 3 EXECUTION.....5
3.01 Examination / Preparation 5
3.02 Installation.....5
3.03 Field Testing / Quality Control 5
3.04 Startup / Demonstration 5
3.05 Adjusting / Protection / Cleanup.....6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

1.04 REFERENCES

A. NYCEC – New York City Electrical Code

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. All equipment and devices, provided under each Contract, shall be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Contract Documents.

B. Similar products shall be by the same manufacturer for uniformity on the Contract.

C. Electrical material and equipment shall be new and shall bear the label of UL, or other nationally recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.

D. Where execution of the work under this Contract requires certain systems and equipment to be modified, the Contractor shall perform the Work with due regard to maintenance of operations and construction staging in accordance with the Contract Documents.

E. The modification work shall be coordinated in advance with the plant superintendent and existing conditions. Contractor shall field determine and make such investigations as required to determine the functionality of each circuit and identify circuit terminations as required for the modifications intended to ensure the proper interface of all components for a complete functional system.

F. The Contractor shall retain the services of a wiring coordinator, to prepare the point-to-point field wiring diagrams. The wiring coordinator shall have experience

in the development of the diagrams of the type specified and shall have served in a similar role on a project of similar size and complexity.

G. Area Classifications

1. Materials and equipment for all indoor areas shall conform to the area classifications as per the Contract Documents..

2. Materials and equipment for all outdoor areas shall conform to corrosive requirements, of the Contract Documents.

3. The locations and requirements shall be in accordance with the following:

a. Materials, equipment and incidentals installed in wet or corrosive areas shall meet NYCEC and NEMA requirements for corrosive locations. Enclosures installed in wet or corrosive locations shall meet NEMA 4X requirements.

b. Materials, equipment and incidentals installed in hazardous locations shall meet NYCEC requirements for the Class and Division designated. Enclosures installed in hazardous locations shall be provided with stainless steel hardware and watertight gasketing.

c. Materials, equipment and incidentals installed in dusty locations shall meet NYCEC and NEMA 12 requirements.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited, to:

1. Point-to-point field wiring diagrams.

2. Qualifications of proposed wiring coordinator who shall prepare the point-to-point field wiring diagrams.

B. Reports

1. Demonstration of equipment report shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Point-To-Point Field Wiring Diagrams

1. The Contractor shall provide point-to-point field wiring diagrams for all equipment, including equipment provided by Other Contractors.

2. The diagrams shall be developed for performance of the Work and to document terminations. The diagrams shall be prepared based upon approved Shop Drawings of related Contracts and inspections as necessary to complete the diagrams. The diagrams shall include:

a. External wiring for each piece of equipment, panel, instrument, and other devices to control stations, lighting panels, and motor controllers. The diagrams shall include control, status, signal, and power wiring. Power diagrams shall include connections to switchgear, motor control centers, panelboards, panels, and field devices.

b. Numbered terminal block identification for each wire termination.

c. Identification of the assigned wire numbers and color coding for all interconnections.

d. Identification of all wiring by the conduit tag in which the wire is installed.

e. Terminal, junction, and pull boxes through which wiring is routed.

f. Identification of equipment with functional name and number to which wiring is to be connected.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shop Finishes

1. Electrical equipment shall be shop painted in accordance with the requirements of Section 09 91 00 – Painting.

2. Exposed ferrous metal surfaces except aluminum, bronze, brass, and stainless steel components shall be cleaned with a commercial blast and primed with one coat of rust inhibitive primer.

3. Manufactured assemblies such as switchgear, substations, motor control centers, panelboards, and motor controllers shall be shop painted in accordance with the requirements of Section 09 91 00 – Painting.

4. Other equipment shall be painted with the manufacturer's best grade finish paint system compatible with the finish coatings specified in Section 09 91 00 – Painting.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Maintenance of Operations

1. Where execution of the Work under this Contract requires certain equipment to be taken out of service, the Contractor shall perform the Work with due regard to maintenance of operations and construction staging in accordance with the Contract Documents.

2. The Contractor shall schedule the Work in advance with the Engineer so as not to affect proper plant operations. When the Work is scheduled, the Engineer shall be notified 48 hours prior to proceeding with the Work to allow time for the plant superintendent to perform load switching and alternation of equipment.

3. To the maximum extent possible at the end of the workday, all equipment shall be back in place and ready for its normal service use should a plant emergency arise. In addition, should an emergency condition occur during execution of the Work, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.

4. In the event of accidental shutdown of plant equipment, the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. The Contractor shall demonstrate, in the presence of the Engineer, that all electrical systems and electrically operated equipment operates as specified, designed, and as required.

B. The Contractor shall coordinate the demonstration of the electrical systems which are part of other Contracts with the Other Contractors.

C. The demonstration of equipment shall include the following:

1. All power circuits shall be operated to verify proper connection to equipment. Mechanical key-interlocks for circuit breakers shall be operated to verify their proper operation. Power shall be removed and reapplied to automatic transfer switches to verify their operation.

2. Emergency power systems shall be activated to verify their automatic start-up, proper operation while running, and proper deenergization and cool down upon availability of normal power.

3. All pushbuttons, indicating lights, and similar devices shall be operated to verify proper connection and function. All devices, such as pressure and flow switches and similar devices, shall be operated to verify that shut-downs and control sequences operate as required.

4. The Contractor, with coordination of the Other Contractors, shall operate the systems to verify wiring and adjust the controls, as required, to achieve proper operation. This shall include wiring, timing, and switching functions.

D. The Contractor shall provide a demonstration of equipment report. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, and all other pertinent information.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Restoration

1. The Contractor shall field paint after installation marred or scratched surfaces. All scratches, abrasions, and other damage to equipment shall be touch-up painted in accordance with the requirements of Section 09 91 00 – Painting.

END OF SECTION

SECTION 26 05 14 – MEDIUM-VOLTAGE CABLES AND ACCESSORIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing medium-voltage cables and accessories.

1. Medium-voltage cables and accessories shall be provided in accordance with the requirements specified under this Section, and the Contract Documents. Incoming electric service feeder cables shall be provided in accordance with the Contract Documents and requirements of the Electric Utility or Con Edison.

B. Medium-Voltage cables to be provided shall include all accessories.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Medium-voltage as used in this Section and the Contract Documents shall mean all voltages greater than 1000 volts.

2. Medium-voltage cable is an assembly of single or multiple insulated conductors combined with fillers and separators in an enclosing jacket of insulating material.

3. Medium-voltage cables shall mean all insulated electric wires and cables intended for use for medium-voltage circuits.

4. Medium-voltage cable accessories shall mean all devices and items intended to provide mechanical and electrical protection, terminate, connect, splice, insulate, tag, and manage medium-voltage cables in the proposed installation.

5. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the local Electric Utility having jurisdiction.

B. Reference Standards: Medium-voltage cables shall comply with the latest applicable provisions and recommendations of the following:

1. AEIC CS8 - Specification for Extruded Dielectric, Shielded Power Cables Rated 5 through 46 kV

2. ASTM B496 - Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors

3. ICEA S-93-639/NEMA WC74 - Standard for Shielded Power Cables Rated 5-46 kV for the Distributions of Electrical Energy

4. IEEE 48 - IEEE Standard Test Procedures and Requirements for High-Voltage Alternating Current Cable Terminations

5. IEEE 400 - IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above

6. IEEE 576 - IEEE Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

7. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable

8. NETA ATS - NETA Acceptance Testing Specifications

9. NEMA WC 26/EEMAC 201 - Binational Wire and Cable Packing Standard

10. NYCEC - NYC Electrical Code
11. NYCCC - NYC Construction Code
12. UL 1072 - Standard for Medium-voltage Power Cables

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. All medium-voltage cables shall be made by an approved single manufacturer, and in their construction shall be employed the most improved commercial materials and processes of manufacture.

B. Only new medium-voltage cable, manufactured under high standards of production and meeting the approval of the Engineer, shall be used.

C. Medium-voltage cable and accessories shall comply with the requirements of the serving Electric Utility.

D. All medium-voltage cable splicing and terminations shall be done by experienced cable splicers who have worked with similar cable for a period of at least five years, using materials and procedures recommended by the cable manufacturer.

E. All splicing and terminations of medium-voltage cable shall be in accordance with the instructions of the cable manufacturer.

F. The medium-voltage cable manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.

G. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and NETA ATS.

H. The Contractor shall retain the services of the medium-voltage cable manufacturer's representative to certify that the cable installation is in accordance with the manufacturer's requirements.

I. Field Tests:

1. Medium-voltage cables shall be field tested. Field testing for shall be in accordance with the requirements specified in this Section.

2. The Contractor shall retain the services of an independent testing firm who shall perform acceptance testing on the medium-voltage cable installation. The testing firm shall have experience in the inspection and testing of cables of the type proposed for installation and shall be a member company of NETA. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's Literature, specifications and engineering data for the medium-voltage and cables and accessories including but not limited to:

a. Manufacturer and type of cable.

b. Voltage and temperature rating.

c. Conductor material, size, and number of strands composing each conductor.

d. Conductor shield material, type and thickness in inches.

e. Insulation material, insulation thickness in inches, insulation type, percentage level.

f. Insulation shield material, type, and thickness in inches

g. Metallic shield material and thickness in inches.

h. Sheath and or jacket material and thickness in inches.

i. Minimum insulation resistance in megaohms per 1,000 ft. at 20 degrees Celsius.

j. Average outside diameter of bare conductor.

k. Average outside diameter of finished cable and sheath or jacket material.

l. Weight per 1,000 ft. of finished cable.

m. Minimum bending radius of the cable, in inches.

n. Minimum pulling temperatures at which cable may be pulled without damage.

o. Maximum pulling tensions which may be applied to the cable without damage.

p. Literature identifying the methods, tools, and materials which Contractor proposes to use to make splices and terminations. Submittal shall consist of manufacturer's literature evidencing compatibility of the conductor insulation, shield, and jacket of the cable with the splicing or terminating materials and methods which Contractor proposes to use.

q. Manufacturer recommended pulling lubricants.

r. Qualifications of splicing and termination personnel.

2. Description of shop and field testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures

shall be submitted at least 45 days in advance prior to confirmation of witness testing dates and actual testing.

3. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.

4. Qualifications of proposed cable installer shall be submitted. Submit installer experience records with five recent completed installations with names and phone numbers.

5. Certification from medium-voltage cable manufacturer's representative that the medium-voltage cable installation is in accordance with the manufacturer's requirements.

B. Reports:

1. Shop and field test reports shall be submitted.

2. Acceptance testing report shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Medium-voltage cables shall be delivered, stored and handled in accordance with the Contract Documents and the manufacturer's instructions.

2. Deliver medium-voltage cables on factory reels conforming to NEMA WC26. Each end of each length of cable shall be hermetically sealed with the manufacturer’s end caps and securely attached to the reel. Reels with unsealed ends will be rejected.

3. Inspect cable protective coverings for evidence of damage during shipment.

4. Accomplish unloading without contacting cable surface or protective coverings or dropping cable reels from the delivering vehicle to the ground.

B. Storage

1. Store cables on reels on elevated hard surfaces in clean dry locations away from construction equipment, falling objects, sources of high heat, and chemicals or petroleum products.

2. Seal cut cable ends using properly sized heat shrink cap to prevent moisture ingress and wicking into the cable interior.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Medium-Voltage cable shall be as manufactured by

1. Okonite Company, Orangeburg, SC;
2. Kerite Company, Seymour, CT;
3. Or approved equal.

B. Connectors shall be as manufactured by:

1. Thomas and Betts, Memphis, TN;
2. Burndy, Manchester, NH;
3. Or approved equal.

C. Terminations shall be as manufactured by:

1. Elastimold – Thomas and Betts, Memphis TN;
2. G&W Electric, Bolingbrook, IL;
3. Raychem Corporation, Chicago, IL;
4. 3M – St. Paul, MN;
5. Or approved equal.

D. Splices shall be manufactured by:

1. Elastimold – Thomas and Betts, Memphis TN;
2. G&W Electric Company, Bolingbrook, IL;
3. Raychem Corporation, Chicago, IL;
4. 3M- St. Paul, MN;
5. Or approved equal.

E. Fireproofing Tape shall be manufactured by:

1. 3M – St Paul, MN;
2. Or approved equal.

F. Glass Tape shall be manufactured by:

1. 3M – St Paul, MN;

2. Or approved equal.

G. Pulling lubricant shall be as manufactured by:

1. American Polywater Corporation, Stillwater MN;

2. 3M – St. Paul, MN;

3. Ideal Industries, Sycamore, IL;

4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Medium-Voltage Cable

1. Medium-voltage cable shall be rated for a 133% insulation level at the system nominal phase voltage. Cable insulation shall be lead free thermosetting ethylene propylene rubber based, suitable for normal installation, indoors or outdoors, in conduit, in air, in underground ducts and intermittent or continuous submersion in water. Medium-voltage cable shall consist of either single or multi-conductor cable bearing the UL "MV 105" label and comply with or exceed ICEA S-93-639 and AEIC CS8.

2. The size and quantity of medium-voltage cable shall be as indicated in the conduit and cable schedule. Medium-voltage cable shall be in accordance with the following:

a. Conductors shall be soft annealed uncoated copper with concentric-lay Class B compact round stranding in accordance with the current ASTM Standard B 496.

b. The cable insulation system shall be comprised of a conductor shield overlaid by the primary insulation overlaid by the insulation shield.

1) The conductor shield shall consist of an extruded layer of non-conducting energy suppression or semiconducting material.

2) The primary insulation shall be a high quality ozone resistant lead free ethylene-propylene rubber based compound. The insulation system shall be suitable for use at conductor temperatures not exceeding 105 degrees Celsius for normal operation, 140 degrees Celsius for emergency overload conditions, and 250 degrees Celsius for short circuit conditions. Minimum average thickness of the insulation system at any point of the cable shall not be less than 115 mils for 5 KV systems, 220 mils for 15 KV systems and 345 mils for 25 KV systems. The minimum thickness at any part of the cable shall not be less than 90 percent of the specified average.

3) The insulation shield shall be layer of semi-conducting material.

4) The metallic shield shall overlay the insulation shield and shall be a copper tape applied helically with a nominal 25 percent overlap. The minimum thickness of the copper tape shield shall be five mil.

c. A continuous jacket of moisture, heat, oil, sunlight, and UV-resistant thermoset chlorinated polyethylene base compound shall be applied over the metallic shield. The average minimum thickness of the jacket at any point of the cable shall be in accordance with ICEA S-93-639.

B. Accessories

1. Cable connectors shall be provided for connecting medium-voltage cable. Connectors shall be in accordance with the following:

a. Connectors shall be copper, tin-plated, long barrel compression type, UL listed. Suitable for voltage applications up to 35KV.

b. For sizes 250MCM and larger, connectors shall be two holes mount type with provisions for two bolts for joining to apparatus terminal.

2. Cable terminators shall be provided for terminating medium-voltage cable. Terminations shall be in accordance with the following:

a. Cable terminations shall meet Class 1 requirements and be design-proof tested per IEEE 48.

b. Terminations shall be of the molded elastomer, wet-process porcelain, cold-shrink or heat-shrinkable types with grounding provisions for the cable shielding.

3. Cable splices shall be provided for splicing medium-voltage cable, splicing shall be in accordance with the following:

a. Cable splices shall be made using standard splice kits which reinstate the cable's insulation and jacket and continue the metallic shielding through the entire cable joint.

b. Splices shall be of the premolded, conventional tape cold-shrink or heat-shrinkable type.

4. Fireproofing Tape shall be in accordance with the following:

a. Minimum thickness 30 mils

b. Resistant to water, salt water, acids, sewage, fungus and UV light

c. Flexible unsupported elastomer

d. Intumescent and self-extinguishing

5. Glass Tape shall be in accordance with the following
   a. Minimum width 0.5 inch
   b. Minimum temperature rating 450 degrees Fahrenheit
   c. Pressure sensitive
6. Medium-voltage cable pulling compound shall be used to reduce cable tension and side wall pressure and aid in minimizing damage during medium-voltage cable installation. Pulling lubricant shall be in accordance with the following:
   a. UL Listed, compatible with the cable jacket, the raceway involved and acceptable to the cable manufacturer.
   b. Pulling lubricant shall be water based, with a 0.17 average coefficient of friction and a temperature range of 20 to 120 degrees Fahrenheit.
   c. Pulling lubricant shall confirm to IEEE 1210
   d. Pulling lubricant shall not support combustion.
   e. Pulling lubricant shall not cause residue to cement jackets to the inside of conduit or ducts.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:
   1. Shop testing shall be performed on the medium-voltage cable at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of ICEA and UL and shall demonstrate that the cable tested conforms to the requirements specified.
   2. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
   3. All medium-voltage cables shall be shop tested in accordance with the following:
      a. Conductors shall meet the electrical resistance requirements of ICEA-S-93-639, Part 2.4.
      b. Insulation Resistance test shall be performed in accordance with the requirements of ICEA S-93-639, Part 4.3.2.5. Each cable shall have an insulation resistance not less than that corresponding to the insulation resistance constant of 20,000 megohms - 1000 ft. at 15.6 degrees Celsius.

c. A high voltage AC test shall be performed in accordance with the requirements of ICEA S-93-639, Part 4.0.

d. Shield resistance shall be measured and recorded from end to end on the completed cable.

e. Each reel of completed shielded power cable shall be partial discharge tested in accordance with ICEA S-93-639 Part 4.3.2.2.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with this Section.

2. The Engineer shall have access during working hours for inspection purposes to all parts of the works where material and cable are being manufactured, and all reasonable inspection and testing facilities shall be provided to him without increase in price. The Engineer may request that dielectric strength tests and measurements be made to verify the cable data furnished by the Contractor. For this purpose, the Contractor shall furnish without increase in price, a length of cable, not to exceed three feet for each size to be cut from one or more reels as directed by the Engineer. Each sample shall be marked with a tag bearing full description of cable insulation and number of reel from which it is cut.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. All medium-voltage cables shall be installed within the raceways as shown on the Contract Drawings. They shall be carefully handled so as to avoid twists or kinks in the conductors or damage to the insulation.

B. The Contractor shall ensure that the manufacturer's recommended cable bending radii and pulling forces and corresponding tension in the cable are not exceeded and that the number of conductors permitted in a conduit are in accordance with the latest applicable requirements of the New York City Electrical Code.

C. No splices shall be permitted between terminals except at approved junction or terminal boxes. Boxes shall be provided as shown on the Contract Drawings or as required by Code for the pull lengths.

D. No more than two terminations shall be made at each terminal point.

E. Cable and wire runs shall be looped through pull boxes without cutting and splicing where possible.

F. All splices below grade, in manholes, hand holes and wet locations shall be waterproofed and fireproofed

3.02 INSTALLATION

A. Cables

1. Medium-voltages cables shall be installed complete with proper terminations at both ends. For each circuit, Contractor shall ensure proper phasing and phase sequence.

2. Medium-voltage cables contained within a single conduit shall be pulled simultaneously using insulating pulling compounds containing no mineral oil.

3. Pulling tension on medium-voltage cables shall be continuously monitored using a calibrated Dynamometer type device, having a calibration label within six months of its use.

4. Medium-voltage cables shall be installed with maximum slack at all terminal points, boxes, handholes, and manholes.

5. Medium-voltage cables located within vaults, manholes, handholes and boxes shall be wrapped with fireproofing tape for their entire length on an individual cable basis. Medium-voltage cables shall be fireproofed in accordance with the cable manufacturer's recommendations and then covered with glass tape extending at least one inch into any duct.

B. Identification

1. Each cable and conductor shall be labeled at each termination point and all splice locations. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification stamped on terminal boards when provided or the cable so it is visible around the cable's circumference.

2. Each conductor shall be identified in junction boxes, cabinets, and terminal boxes. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper, self-adhesive wire markers shall not be used.

3. In manholes and handholes, each cable shall be identified by a laminated plastic tag located so that it can be seen from center of manhole without moving adjoining wires. Bundle and mark cables as listed in conduit and cable schedule.

4. Medium-voltage cables shall be color coded by a bright yellow colored tape band. Conductor identification shall be marked by a single wrap for Phase A, a double band for Phase B, and three bands for Phase C.

3.03 FIELD TESTING / QUALITY CONTROL

A. The Contractor shall provide acceptance testing of the medium-voltage cable. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

1. Each medium-voltage cable circuit shall be acceptance tested on an individual per phase basis, all testing and inspection shall be performed by the testing firm.
2. Visual and mechanical inspection shall be performed for all splices and terminations.
3. Electrical tests shall be performed for each cable. Testing shall include the shield continuity test and the DC high potential test and shall be in accordance with the following:
    a. The following procedures shall be adhered to before performing dc over potential tests:
        1) All equipment transformers, switches, motors, circuit breakers, surge arrestors, etc. shall be disconnected from cable circuit to prevent test interruptions due to flashovers or trip outs resulting from excessive leakage current.
        2) Adequate clearance shall be established between the circuit test ends and any grounded object and to other equipment not under test.
        3) Circuit conductors not under test shall be grounded including all cables shields and nearby equipment.
        4) Insulation surfaces shall be cleaned.
        5) Cable ends shall be keep dry.
    b. High-potential shall be applied slowly in eight to ten equal steps to 80 percent of the NETA test value or manufacturer's shop production test value, whichever is smaller. Record the leakage current at each test voltage and plot the curve on graph paper.
    c. The test shall be stopped, if the leakage current increases excessively or a "knee" appears in the curve before reaching maximum test voltage.
    d. Upon reaching the specified maximum test voltage, the voltage shall be maintained for 15 minutes, record the leakage current at 30 seconds and one minute, and at one-minute intervals thereafter. Plot leakage current versus time on the same graph as the step voltage curve.
    e. Conductor test potential shall be reduced to zero and measure residual voltage at discrete intervals.
    f. Grounds shall be applied to drain all insulation stored charge. Conductors shall be connected to ground through a suitable discharge resistor for one minute and then subsequently grounded directly.

g. New cable failing the test shall be replaced and retested.

h. The test curves shall be signed by the tester and initialed by the Engineer.

4. All tests and values for cable shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.

5. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA, ATS Acceptance Testing Specification.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 20 – LOW-VOLTAGE WIRES, CABLES AND ACCESSORIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing low-voltage electric wires, cables, and accessories.

1. Low-voltage electric wires, cables, and accessories shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

B. Low-voltage electric wires and cables to be provided shall include all accessories.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	12
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

2. Low-voltage wires and cables shall mean all insulated electric wires and cables intended for use for power, lighting, control, instrumentation, communication, security, and alarm circuits.

3. Low-voltage wires and cable accessories shall mean all devices and items intended to provide mechanical protection, terminate, connect, splice, insulate, tag, and manage low-voltage wires and cables.

4. Cable is an assembly of insulated wires combined with fillers and separators in an enclosing jacket of insulating material.

5. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the Local Electric Utility having jurisdiction.

B. Reference Standards

Low-voltage wires and cables shall comply with the latest applicable provisions and recommendations of the following:

1. ANSI/ICEA S-95-658/
   NEMA WC70 - Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy

2. ASTM B5 - Standard Specification for High Conductivity Tough-Pitch Copper Refinery Shapes

3. ASTM B8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

4. ASTM D69 - Standard Test Methods for Friction Tape

5. ASTM D2301 - Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

6. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

7. ICEA S-58-679 - Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification

8.	IEEE 1210	-	Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable
9.	NEMA WC 26/ EEMAC 201	-	Binational Wire and Cable Packing Standard
10.	NETA ATS	-	NETA Acceptance Testing Specifications
11.	NYCEC	-	NYC Electrical Code
12.	NYCCC	-	NYC Construction Code

13. UL Standard 486A-486B - Wire Connectors

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General:

1. All low-voltage wires, cables and accessories shall be made by an approved manufacturer, and in their construction shall be employed the most improved commercial materials and processes of manufacture.

2. Only low-voltage wires, cables, and accessories manufactured under high standards of production and meeting the approval of the Engineer shall be used.

3. Friction tape shall be in accordance with ASTM. D69.

4. All low-voltage wire and cable splicing and terminations shall be done by experienced cable splicers who have worked with similar wire and cable for a period of at least five years, using materials and procedures recommended by the wire and cable manufacturer. All splicing and terminations of low-voltage wire and cable shall be in accordance with the instructions of the low-voltage wire and cable manufacturer.

5. The low-voltage wire and cable manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.

6. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.

7. The mineral-insulated metal sheath cable installation shall be performed by experienced mineral-insulated metal sheath cable installers who shall have been regularly engaged in the installation of mineral-insulated metal sheath cable for a minimum of the past three years.

8. The Contractor shall retain the services of the mineral-insulated metal sheath cable manufacturer's representative to certify the cable installation is in accordance with the manufacturer's requirements.

9. Field testing of low-voltage wires and cables shall be in accordance with the requirements specified under this Section.

10. The Contractor shall retain the services of an independent testing firm who shall perform acceptance testing on the low-voltage wire and cable installation.

    a. The testing firm shall have experience in the inspection and testing of wires and cables of the type specified and shall be a member company of NETA.

    b. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

    c. The testing shall be performed in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. A list of proposed manufacturers shall be submitted with the products they produce proposed for the contract.

2. Manufacturer's Literature, specifications and engineering data for low-voltage wires, cables and accessories including but not limited to:

    a. Manufacturer and type of wire or cable.

    b. Minimum insulation resistance in megaohms per 1,000 ft. at 20 degrees Celsius.

    c. Material, number, and size of strands composing each conductor.

    d. Conductor insulation thickness in inches with material and voltage rating.

    e. Jacket thickness in inches.

    f. Average outside diameter of bare conductor.

    g. Average outside diameter of finished wire or cable and jacket material.

    h. Weight per 1,000 ft. of finished wire or cable.

    i. Minimum bending radius, in inches.

    j. Minimum pulling temperatures at which cable may be pulled without damage.

k. Maximum pulling tensions which may be applied to the cable without damage.

l. Literature identifying the methods and materials which Contractor proposes to use to make splices and terminations. Submittal shall consist of manufacturer's literature evidencing compatibility of the conductor insulation and jacket of the wire or cable with the splicing or terminating materials and methods which Contractor proposes to use.

m. Manufacturer recommended pulling lubricants.

n. Qualifications of splicing and termination personnel.

3. Description of shop and field testing methods, procedures, and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 45 days in advance prior to confirmation of witness testing dates and actual testing.

4. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing; five recent references with phone numbers shall be submitted.

5. Qualifications of proposed mineral-insulated metal sheath cable installer shall be submitted. Submit installer experience records with five recent completed installations with names and phone numbers.

6. Certification from the mineral-insulated metal sheath cable manufacturer's representative that the cable installation is in accordance with the manufacturer's requirements.

B. Reports:

1. Shop and field test reports shall be submitted.

2. Acceptance testing report shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Low-voltage wires and cables shall be delivered, stored, and handled in accordance with the Contract Documents and the manufacturer's instructions.

B. Deliver low-voltage cables on factory reels conforming to NEMA WC26. Each end of each length of cable shall be hermetically sealed with the manufacturer’s end caps and securely attached to the reel. Reels with unsealed ends will be rejected.

C. Inspect wire and cable protective coverings for evidence of damage during shipment.

D. Accomplish unloading without contacting cable surface or protective coverings or dropping cable reels from the delivering vehicle to the ground.

E. Store wires and cables on reels on elevated hard surfaces in clean, dry locations away from construction equipment, falling objects, sources of high heat, and chemicals or petroleum products.

F. Seal cut cable ends using properly sized heat shrink cap to prevent moisture ingress and wicking into the cable interior.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Low-voltage single conductor wires for installation in conduit shall be as manufactured by:

1. Southwire, Carrollton, GA;
2. General Cable, Highland Heights, KY;
3. Okonite Company, New York, NY;
4. Or approved equal.

B. Low-voltage cable shall be as manufactured by:

1. Southwire, Carrollton, GA;
2. General Cable, Highland Heights, KY;
3. Belden; Indianapolis, IN
4. Okonite Company, New York, NY;
5. Or approved equal.

C. Compression connectors ring tongue type shall be manufactured by:

1. Ideal Industries, Sycamore, IL;
2. Thomas and Betts, Memphis, TN;
3. Burndy, Manchester, NH;
4. Or approved equal.

D. The mineral-insulated metal sheath cable shall be as manufactured by:

1. Pentair Pyrotenax, Houston, TX;

2. AFC Cable Systems, New Bedford, MA;
3. Or approved equal.

E. Compression splices shall be manufactured by:
1. Ideal Industries, Sycamore, IL;
2. Thomas and Betts, Memphis, TN;
3. Burndy, Manchester, NH;
4. Or approved equal.

F. Waterproof compression splices shall be manufactured by
1. Ideal Industries, Sycamore, IL;
2. Thomas and Betts, Memphis, TN;
3. Burndy, Manchester, NH;
4. Or approved equal.

G. Spring connector splices shall be manufactured by:
1. Ideal Industries, Sycamore, IL;
2. Thomas and Betts, Memphis, TN;
3. Burndy, Manchester, NH;
4. Or approved equal.

H. Markers shall be as manufactured by:
1. Ideal Industries, Sycamore, IL;
2. Thomas and Betts, Memphis, TN;
3. Brady, Milwaukee, WI;
4. Or approved equal.

I. Pulling lubricant shall be as manufactured by:
1. American Polywater Corporation, Stillwater MN;
2. 3M – St. Paul, MN;
3. Ideal Industries, Sycamore, IL;
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Low-voltage Voltage wire and cable
1. Low-voltage wire and cable shall be used for all power, lighting, control instrumentation, alarm, and security system circuits. The size and quantity of low-voltage wires and cables shall be as indicated in the conduit and

cable schedule. The conductor jacket shall be in accordance with color identification requirements specified under this Section.

2. Low-voltage single conductor wires for installation in conduit shall be in accordance with the following:
   a. Conductors shall be stranded, copper, single conductor wire conforming to ASTM B8, and B33 No. 12 AWG minimum size.
   b. Conductor insulation shall be flame-retardant, moisture and heat resistant thermoset rated 90 degrees C in dry locations and 75 degrees C in wet locations and listed by UL as type XHHW-2 or RHW-2.
   c. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground and outdoor circuits.
3. Low-voltage cable for installation in conduit shall be in accordance with the following:
   a. Conductors shall be stranded, copper conforming to ASTM B8 and B33, No. 12 AWG minimum size.
   b. Conductor insulation shall be moisture and flame-resistant cross-linked polyethylene rated 90 degrees Celsius in wet and dry locations and listed by UL as type XHHW-2.
   c. Cable conductors shall be assembled together with flame and moisture resistant filters and tape to make round.
   d. Cable shall include an overall protective jacket of polyethylene compound, 45 mils minimum thickness.
4. Instrumentation cable shall in addition comply with the following:
   a. Conductors shall No 16 AWG minimum size
   b. All conductors shall be polyethylene insulated and twisted in pairs with aluminum-mylar shield overlap.
   c. Cable jacket shall be low halogen
5. Communication cable shall in addition comply with the following:
   a. Conductors shall be No 24 AWG minimum size.
   b. Conductor twist and shielding shall be as per the Contract Documents.
   c. Cable jacket shall be low halogen
6. Fire Alarm cable shall in addition comply with the following:
   a. Conductors shall 18 AWG minimum size
   b. Cables shall be UL listed for the intended service

c. Cables intended for use in the installation shall be approved for the intended use by the New York City Building Department, Material and Equipment Acceptance Division.

7. Security system cable shall in addition comply with the following:

a. Conductors shall be No 22, AWG minimum size.

b. Conductor twist and shielding shall be as per the Contract Drawings or as stated in this Section.

c. Coaxial cable shall be as shown on the Contract Documents.

8. Mineral-insulated metal sheath cable shall be used for the fire pump circuits. The mineral-insulated metal sheath cable shall be in accordance with the following:

a. The mineral-insulated metal sheath cable shall be NYCEC, type MI. The cable assembly shall be UL listed including support for a two hour fire rating.

b. Conductors shall be solid copper conforming to ASTM B5.

c. Cable insulation shall be magnesium oxide mineral rated 600 volts, 90 degrees Celsius. The cable shall include a metal-sheath consisting of seamless soft drawn copper.

d. The cable shall be provided with all fittings and hardware necessary for proper installation.

B. Low-voltage wire and cable accessories

1. Cable connectors shall be provided for terminating low-voltage wire and cable. Connectors shall be solder less type and properly sized to fit fastening device and wire size. Connectors shall be in accordance with the following:

a. For wire sizes up to and including No. 6 AWG, compression type with UL 486A listing shall be used. All cable terminations for conductors No. 10 AWG and smaller shall be terminated using UL listed terminals, connectors, at each terminal board.

b. For wire sizes No. 4 AWG and above, either compression type or bolted type with tin-plated contact faces shall be used.

c. For wire sizes No. 250 kcmil and larger, connectors with at least two cable clamping elements or compression indents and provision for at least two bolts for joining to apparatus terminal shall be used.

2. Splicing for low-voltage wire and cable shall be performed when terminals are not provided. Splicing shall be in accordance with the following:

a. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings with UL 486A listing. Splices shall be taped and covered with materials recommended by the cable manufacturers, to provide insulation equal to that on the conductors.

b. For wire sizes No. 10 AWG and smaller, splices shall be made up with preinsulated, spring connectors. Connectors shall be flame retardant with UL listing. Spring connectors shall be Twister type.

c. For wet locations, splices shall be waterproofed. Compression type splices shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductor. Waterproof compression splices shall be UL listed, heavy wall type. Spring connector splices shall be UL listed and waterproofed with a sealant-filler. Spring connectors shall be Twister DB type.

3. Compression connectors shall be UL listed terminals.

4. Cable markers shall be provided for the identification of low-voltage wire and cable. Markers shall be in accordance with the following:

a. Markers shall be vinyl type, moisture, heat and abrasion resistant with adhesive back. Cable identification shall be clearly marked.

5. Low-voltage wire and cable pulling lubricant shall be used to reduce wire and cable tension and side wall pressure and aid in minimizing damage during low-voltage wire and cable installation. Pulling lubricant shall be in accordance with the following:

a. UL Listed, compatible with the wire insulation or cable jacket, the raceway involved and acceptable to the wire and cable manufacturer. When wire and cable manufacturer shall be provided.

b. Pulling lubricant shall be water based, with a 0.17 average coefficient of friction and a temperature range of 20 to 120 degrees Fahrenheit.

c. Pulling lubricant shall confirm to IEEE 1210

d. Pulling lubricant shall not support combustion.

e. Pulling lubricant shall not cause residue to cement insulation or jackets to the inside of conduit or ducts.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the low-voltage wire and cable at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of ICEA and UL and shall demonstrate that the wire and cable tested conforms to the requirements specified.
2. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
3. All low-voltage wire and cable shall be shop tested in accordance with the requirements of the Contract Documents.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with this Section.
2. The Engineer shall have access during working hours for inspection purposes to all parts of the works where material and cable are being manufactured, and all reasonable inspection and testing facilities shall be provided to him without increase in price. The Engineer may request that dielectric strength tests and measurements be made to verify the cable data furnished by the Contractor. For this purpose, the Contractor shall furnish without increase in price, a length of cable, not to exceed three feet for each size to be cut from one or more reels as directed by the Engineer. Each sample shall be marked with a tag bearing full description of cable insulation and number of reel from which it is cut.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. All low-voltage wires and cables shall be installed within the raceways as shown on the Contract Drawings. They shall be carefully handled so as to avoid twists or kinks in the conductors or damage to the insulation.

B. The Contractor shall ensure that the manufacturer's recommended cable bending radii and pulling are not exceeded and that the number of conductors permitted in a conduit are in accordance with the latest applicable section of the NYCEC.

C. No splices shall be permitted between terminals except at approved junction or terminal boxes. Boxes shall be provided as shown on the Contract Drawings or as required by Code for the pull lengths. No more than two terminations shall be made at each terminal point. Cable and wire runs shall be looped through pull boxes without cutting and splicing where possible. All splices below grade, in manholes, hand holes, and wet locations, shall be waterproofed.

D. No splicing of instrument wiring shall be permitted. Instrument wiring shall be extended by use of field termination boxes employing labeled terminal strips. Shield continuity shall be maintained. Ultimate shield termination (ground) shall be at one end only.

E. The mineral-insulated metal sheath cable manufacturer's representative shall review the cable installation to certify that the cables are installed in accordance with the manufacturer's requirements.

3.02 INSTALLATION

A. Wire and Cables

1. Cables shall be installed completely with proper terminations at both ends. For each motor circuit, Contractor shall ensure proper phasing, phase sequence, and motor rotation.

2. Wire and cable contained within a single conduit shall be pulled simultaneously using insulating pulling compounds containing no mineral oil.

3. Pulling tension on wires and cables shall be continuously monitored using a calibrated Dynamometer type device, having a calibration label within six months of its use.

4. Cables shall be installed with maximum slack at all terminal points, boxes, handholes, and manholes.

5. Low-voltage cables located within manholes, handholes, and boxes shall be wrapped with fireproofing tape for their entire length on an individual cable basis.

   a. Tape shall be 30 mills thick of self-extinguishing material which will not support combustion.

   b. Tape shall not deteriorate when subjected to water, salt, sewage or fungus and shall be secured with glass cloth tape.

   c. Low-voltage cables shall be fireproofed in accordance with the cable manufacturer's recommendations and then covered with tape extending at least one inch into any duct.

B. Conductor Identification

1. Each conductor shall be labeled at each termination point and all splice locations. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification stamped on terminal boards when provided or the cable so it is visible around the cable's circumference.

2. Each conductor shall be identified in junction boxes, cabinets, and terminal boxes. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper, self-adhesive wire markers shall not be used.

3. In manholes and handholes, each power conductor shall be identified by a laminated plastic tag located so that it can be seen from center of manhole without moving adjoining wires. Bundle and mark control wires as listed in conduit and cable schedule.

4. Multi-conductor control cables shall be color coded in accordance with ICEA S-58-679, Method 1, Table E

5. The following identification scheme shall be used for all low-voltage power circuits:

	Colors				
Voltage	Neutral Conductor	Phase A Conductor	Phase B Conductor	Phase C Conductor	Ground Conductor
208/120V	White	Black	Red	Light Blue	Green
240/120V	White-Gray Strip	Black-Blue Strip	Red-Blue Strip	None	Green
480/277V	Gray	Brown	Orange	Yellow	Green

3.03 FIELD TESTING / QUALITY CONTROL

A. After installation, all low-voltage wire and cable shall be field tested. The field tests shall be performed by the Contractor who shall furnish all testing equipment. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide a report identifying the tests performed and the results obtained.

B. Each electrical circuit shall be tested after permanent wires and cables are in place to demonstrate that the circuit and equipment are connected properly and will perform satisfactorily, as required, as intended, and that they are free from improper grounds and short circuits. The tests shall consist of the following:

1. Low-voltage wire and cable mechanical connections shall be individually tested after installation and before they are put in service with a calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.

2. Low-voltage wires and cables shall be individually tested for continuity between the required termination points for each ungrounded and grounded conductor. Test wire and cable after installation and before first energization, or before they are put in service with an approved continuity tester. Test results shall be as recommended by the wire and cable manufacturer or in accordance with NETA ATS, NEMA, ICEA Standards.

3. Low-voltage wires and cables shall be individually tested for insulation resistance between ungrounded and grounded conductors, and from each ungrounded and grounded conductor to ground. Test wire and cable after installation and before first energization or before they are put in service with an approved insulation resistance tester, for one minute at a voltage rating recommended by the cable manufacturer or in accordance with NETA ATS, NEMA, and ICEA Standards.

4. The insulation resistance for any given conductor shall not be less than the value recommended by the cable manufacturer or in accordance with NETA ATS, NEMA and ICEA Standards. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.

5. Shielded instrumentation cable shields shall be tested with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.

6. Connect Shielded instrumentation cables shall be connected to a calibrated 4-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 05 27 – GROUNDING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing grounding.

1. Grounding shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

2. The grounding Work shall be a complete system for the electrical and instrumentation systems, structures, and equipment. The Work shall include grounding of all electrical equipment, transformer neutrals, equipment enclosures, grounding electrodes, fences, and gates.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 20 – Low -Voltage Wires, Cables and Accessories

B. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.04 REFERENCES

A. Definitions

1. Grounding

a. Grounding and grounding system shall be used interchangeabley in this Section and the Contract Documents to mean the means and methods by which all electrical and instrumentation systems are grounded for the purposes of attaining safety grounding, equalization of ground potential, reducing ground potential rises during fault events, and the grounding of the ungrounded conductor as required by the NYCEC and Electric Utility Standards

2. Electric Utility

a. All references to the Electric Utility shall mean the Consolidated Edison Company or the Local Electric Utility having jurisdiction.

B. Reference Standards

1.	ASTM B8	-	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
2.	NYCEC	–	New York City Electrical Code
3.	Electric Utility	-	Standards and Guidelines
4.	UL 467	-	Electrical Grounding and Bonding Equipment

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. The grounding system maximum resistance shall not exceed five ohms under normally dry conditions. All structures and metal equipment containing electrical apparatus shall be connected to ground.

All grounding associated with the service feeders shall be in accordance with the requirements of the Electric Utility.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. A list of proposed manufacturers with the products they produce proposed for the contract.

2. Manufacturer's catalog cuts for the grounding materials proposed for use.

3. Scaled Shop Drawings showing proposed routing and layout of the grounding system.

B. Field test report shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The grounding equipment shall be delivered, stored and handled in accordance with this Section, the Contract Documents and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ground cable shall be as manufactured by:

1. Erico, Solon, OH;

2. Harger, Grayslake, IL;

3. General Cable, KY;

4. Or approved equal.

B. Ground rods shall be as manufactured by:

1. Erico, Solon, OH;

2. Harger, Grayslake, IL;

3. Blackburn/Thomas and Betts, MN;

4. Thompson Lightning Protection Inc, MN;

5. Or approved equal.

C. Bolted or compression grounding connectors shall be as manufactured by:

1. Burndy, Manchester, NH;

2. Harger, Grayslake, IL;

3. Thomas and Betts, Memphis, TN;

4. Or approved equal.

D. Welded grounding connections shall be as manufactured by:

1. Cadwell, Solon OH;
2. Harger, Grayslake, IL;
3. Or approved equal.

E. Ground Resistance Tester shall be as manufactured by:

1. Fluke, Everett, WA.
   a. Model 1625-2 GEO or approved equal.
2. Megger, Dallas, TX.
   a. Model DET 2/3 or approved equal.
3. AEMC Instrument, Dover, NH.
   a. Model 6471 or equal
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Ground Cable

1. The ground cable shall be soft drawn bare stranded copper conforming to ASTM B8, No. 8 AWG minimum size.
2. The insulated cable for equipment grounding shall conform to the requirements of Section 26 05 20 – Low-Voltage Wires, Cables and Accessories.

B. Ground Rods

1. Ground rods shall be stainless steel, 3/4-inch diameter and 10 feet long.
2. Ground rods shall have a drive point at the lower ends. The upper end of each rod shall be equipped with bronze, clamp type connectors with not less than four bolts.

C. Grounding Connectors.

1. Compression connectors shall be heavy duty copper. Bolted connectors shall be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers.
2. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. A complete ground grid system shall be installed as shown on the Contract Drawings.

B. Ground cable shall be installed around perimeter of structures at a minimum of two feet-six-inches below grade.

C. Ground rods shall be installed two feet below grade, two feet from foundation walls and shall extend ten feet vertically into the earth or horizontally not less than 36 inches below grade.

D. Test points shall be installed at locations and in accordance with the details shown on the Contract Drawings.

E. Equipment shall be connected in accordance with the details shown on the Contract Drawings. All steel column and underground connections shall be welded except for test points.

F. Metal casings or supporting frames of electrical equipment, such as transformers, panel boards, control panels, motor control centers, and individual motor controllers shall be grounded. The equipment shall be thoroughly grounded to the facility grounding system. All metal conduits leaving all electrical equipment shall be grounded. Grounding type fittings shall be installed on flexible conduits.

G. An insulated cable for equipment grounding shall be installed with the phase conductors within the conduit for the nominal 120 volt and higher power, lighting and control circuits.

3.03 FIELD TESTING / QUALITY CONTROL

A. After installation, the completed ground system shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:

1. Resistance testing shall be made using approve Earth Ground Resistance Testers not less than 48 hours after rainfall.

2. Resistance values above five ohms shall be brought to the Engineer's attention with remedial recommendations.

3. Grounded cables and metal parts shall be continuity tested. The conduit system shall be ground tested in accordance with the requirements of Section 26 05 33 – Raceway and Boxes for Electrical Systems.

B. The Contractor shall provide a Field Test Report, the report shall identify the testing performed and the results obtained.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing supporting devices.

1. Supporting devices shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

2. The supporting devices shall be a complete system for the equipment.

3. The Work shall include providing all required support devices to properly mount and secure all equipment furnished under this Contract.

B. This Section also includes equipment anchorage and restraints suitable to meet the specified seismic requirements.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.04 REFERENCES

A. Supporting devices shall comply with the latest applicable provisions and recommendations of the following:

1. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy, High-Strength, Low-Alloy with Improved Formability, and Ultra-High Strength
2. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
3. MFMA 103 – Guidelines for the Use of Metal Framing
4. MFMA 4 – Metal Framing Standards Publication
5. ASTM A123 and A153 – Hot Dipped Galvanized Finish
6. ASTM B117 – Salt Fog Spray Test
7. ASTM A1046 and 1059 – Defender Finish

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General

1. All channels, fittings and hardware used in the supporting system shall be in accordance with MFMA 4 and MFA 103.
2. The design of the support system shall be the responsibility of the Contractor. The Contractor shall provide the proper sized rods, channels, fittings, brackets, and appurtenances necessary to adequately support the equipment.
3. The Contractor shall retain the services of a licensed Professional Engineer, registered in the State of New York, to prepare support details for equipment exceeding 50 pounds in weight. The Professional Engineer shall stamp the support system design details.

B. Seismic Requirements

1. Equipment assemblies such as secondary unit substations, switchgear, transformers, motor control centers, and panelboards shall be certified to meet seismic requirements of the New York City Building Code.
2. The Contractor shall provide equipment anchorage details for all equipment certified to meet seismic requirements. The details shall be coordinated with the manufacturer's equipment mounting provisions.

3. Electric conduit shall include seismic restraints in accordance with the requirements of Section 26 05 33 – Raceways and Boxes for Electrical Systems.

4. The Contractor shall retain the services of a licensed Professional Engineer, registered in the State of New York, to prepare the seismic anchorage and restraint details. The Professional Engineer shall stamp the seismic anchorage and restraint details.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for approval by the Engineer.

B. Submittals shall include, but not be limited to, the following:

1. Manufacturer's catalog cuts for the supporting devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.

2. Scaled Shop drawings showing dimensions and locations of all items and clearance requirements.

3. Support design details and equipment seismic anchorage and restraint details, stamped by a Licensed Engineer as required.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The supporting devices shall be delivered, stored, and handled in accordance with this Section, the Contract Documents, and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Supporting devices shall be manufactured by:

1. B-Line, Highland, IL;

2. Atkore Unistrut/Power Strut, Harvey, IL;

3. Thomas and Betts Kindorf, Memphis, TN;

4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Channels, Fittings and Brackets

1. The Contractor shall provide channels, fittings, brackets, and related hardware for mounting and supporting the electrical equipment. Anchor bolts, concrete inserts, and related hardware for proper support of equipment shall also be provided. All equipment necessary to meet the seismic requirements specified shall be provided.
2. Channels shall conform to ASTM A1011/A1011M. Channels shall have a minimum thickness of 12 gauge. The cross-sectional width dimension shall be 1-1/2 inch minimum. The depth shall be as required to satisfy load requirements.
3. Attachment holes, when required, shall be factory punched on hole centers approximately equal to the cross sectional width and shall be 9/16 inch diameter.
4. Fittings and brackets shall have 9/16 inch diameter holes on centers identical to the channel or as required to align with the channel holes. Fittings and brackets shall have the same width as the channel and shall be 1/4-inch-thick minimum. Fittings and brackets shall mate properly with the channel.
5. All channels, fittings, brackets and related hardware shall be steel and have an electro-plated zinc; for wet areas, outdoor locations, roofs or vents use hot dipped galvanized or defender with self-healing properties finish according to ASTM B633, ASTM A123 and A153, ASTM B117, ASTM A1046 and ASTM A1059.
6. In corrosive and classified areas, channels, fittings, brackets and related hardware shall be type 316 stainless steel or PVC coated. Dissimilar metals shall be avoided when installing stainless steel channels or PVC coated .

B. Conduit Hangers, Supports and Inserts

1. The Contractor shall provide channels, rods, straps, anchors and related hardware for support of the exposed electric conduit system.
2. The Contractor shall also provide anchor bolts, concrete inserts and related hardware for proper support of equipment. All equipment necessary to meet the seismic requirements specified shall be provided.
3. Conduit hangers, supports and inserts shall be in accordance with Section 26 05 33 – Raceway and Boxes for Electrical Systems.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. All supporting devices shall be installed level, parallel and perpendicular to building walls and floors, such that the support system is installed in a neat and professional manner.

B. All holes in hung ceilings for support rods and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.

C. The channels, fittings and brackets shall be rigidly bolted together and braced to make a substantial supporting framework support system.

D. Where motor control centers, switchgear, unit substations and other electrical equipment is being installed on concrete pads, the Contractor shall furnish leveling channels to the Contractor. The Contractor shall install the leveling channel in the concrete pads. Seismic certified equipment shall be anchored in accordance with the seismic anchorage details.

E. All equipment fastenings to steel columns, beams and trusses shall be by beam clamps. In lieu of beam clamps, equipment may be welded to steel structures, subject to Engineer approval.

F. No holes shall be drilled in any steel columns, beams and trusses.

G. Hanger rod supports shall be installed such that threaded rod is parallel to building walls and perpendicular to floors.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing conduit system.

1. The conduit system shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

2. The conduit system required shall be provided with all rigid and flexible conduits, boxes, fittings, supports, hangers, and inserts and other conduit accessories as required for the installation of the electric wire and cable.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	13
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Installation	15
3.03	Field Testing / Quality Control	19
3.04	Startup / Demonstration	20
3.05	Adjusting / Protection / Cleanup	20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 – Miscellaneous Metal Fastenings

B. Section 09 91 00 – Painting

C. Section 40 05 07 – Hangers and Supports for Process Piping

1.04 REFERENCES

A. Definitions

1. Conduit System: Shall mean a complete installation comprising all rigid conduit and flexible connections, boxes, fittings, supports, hangers, inserts, and other conduit accessories as required for the installation of electric wires and cables.

2. Conduit Accessories: Shall mean all fittings required to ensure a complete conduit system installation. Conduit accessories shall include, but are not limited to, expansion, deflection, seal and drain fittings, hubs, bushings, duct seal, tags, markers, thruwall seals, and bushings.

B. References

1. Electric conduit system shall comply with the latest applicable provisions and recommendations of the following:

2.	NYCEC	-	New York City Electrical Code
3.	UL 6	-	Electrical Rigid Metal Conduit - Steel
4.	UL 360	-	Standard for Liquid-Tight Flexible Metal Conduit
5.	UL 514A	-	Metallic Outlet Boxes
6.	UL 514B	-	Conduit, Tubing and Cable Fittings
7.	ANSI C80.1	-	Electric Rigid Steel Conduit
8.	ASTM D870	-	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
9.	ASTM D1735	-	Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
10.	NEMA RN-1	-	PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
11.	ASTM-2247	-	Standard Practice for Testing Water Resistant Coating Using 100% Relative Humidity
12.	ETL-PVC 001	-	PVC Externally Coated Galvanized Conduit PVC Coating Verified for Adhesion

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. A list of proposed manufacturers with the products they produce proposed for the Contract.
2. Manufacturer's catalog cuts for the conduit, boxes, fittings, and supports proposed for use.
3. Construction details of conduit racks and other conduit support systems with seismic restraint details and calculations signed by a licensed Professional Engineer, registered in the State on New York.
4. Scaled Shop Drawings showing proposed routing of all conduits, inclusive of conduits embedded in structural concrete and conduits directly buried in earth.
5. Scaled Shop Drawings showing locations of pull and junction boxes and all penetrations in walls and floor slabs.
6. Field test report.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Electric conduit system shall be delivered, stored, and handled in accordance with the Contract Documents, the manufacturer's instructions, and the following:

1. Conduit shall be delivered to the Site in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the Underwriters' Laboratories, Incorporated inspection service.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Rigid steel conduit shall be as manufactured by:
   1. Atkore/Allied Tube and Conduit Corporation, Harvey, IL;
   2. Wheatland Tube Company, Sharon, PA;
   3. Republic Conduit, Louisville, KY;
   4. Or approved equal.

B. PVC coated rigid steel conduit shall be as manufactured by:
   1. Robroy Industries, Gilmer, TX;
   2. OCAL by Thomas & Betts, Memphis, TN;
   3. Atkore/Calbond, Harvey, IL;
   4. Or approved equal.

C. Hangers, Supports and Inserts shall be as manufactured by:
   1. B-Line, Highland, IL;
   2. Atkore Unistrut / Power Strut Harvey, IL
   3. Kindorf, Harahan, LA;
   4. Or approved equal.

D. Flexible conduit shall be as manufactured by:
   1. Anaconda American Brass Company, Rolling Meadows, IL;
   2. Atkore AFC Cable New Bedford MA
   3. Electric-Flex Company, Roselle, IL;
   4. Or approved equal.

E. Hazardous area flexible conduit shall be as manufactured by:
   1. Crouse Hinds Company, Syracuse, NY;
   2. Appleton Electric Company, Rosemont, IL;
   3. Or approved equal.

F. Unions in hazardous locations shall be as manufactured by:
   1. Crouse-Hinds Syracuse, NY;
   2. Atkore/Calbond/Calbrite, Harvey, IL;
   3. Or approved equal.

G. Unions in non-hazardous areas shall be as manufactured by:
   1. Thomas & Betts, Memphis, TN;

2. Or approved equal.

H. Expansion and deflection fittings shall be as manufactured by:

1. Crouse-Hinds, Syracuse, NY;
2. Atkore/Calbond, Harvey, IL;
3. Appleton Electric, Rosemont, IL;
4. Or approved equal.

I. Sealing fittings shall be as manufactured by:

1. Crouse-Hinds, Syracuse, NY;
2. Appleton Electric, Rosemont, IL;
3. Or approved equal.

J. Drain fittings shall be as manufactured by:

1. Crouse-Hinds, Syracuse, NY;
2. Atkore Calbrite, Harvey, IL;
3. Appleton Electric, Rosemont, IL;
4. Or approved equal.

K. Conduit hubs shall be as manufactured by:

1. O-Z/Gedney Rosemont, IL;
2. Atkore/Calbond, Harvey, IL;
3. Thomas and Betts, Memphis, TN;
4. Or approved equal.

L. Conduit bushings and locknuts shall be as manufactured by:

1. O-Z/Gedney, Rosemont, IL;
2. Thomas and Betts, Memphis, TN;
3. Or approved equal.

M. Duct seal shall be as manufactured by:

1. American Polywater Corp, Stillwater, MN;
2. O-Z/Gedney, Rosemont, IL;
3. Ideal Industries, Sycamore, IL;
4. Or approved equal.

N. Thruwall seals shall be as manufactured by:

1. O-Z/Gedney Rosemont, IL;
2. Or approved equal.

O. Floor seals shall be as manufactured by:

1. O-Z/Gedney, Rosemont, IL.;
2. Or approved equal.

P. Sealing bushings shall be as manufactured by:

1. O-Z/Gedney, Rosemont, IL;
2. Or approved equal.

Q. Fire stop fittings shall be as manufactured by:

1. O-Z/Gedney, Rosemont, IL;
2. Or approved equal.

R. Thru-wall barriers shall be as manufactured by:

1. Crouse-Hinds, Syracuse, NY;
2. Or approved equal.

S. Conduit tags shall be as manufactured by:

1. Seton Nameplate Corporation, Branford, CT;
2. Or approved equal.

T. Conduit markers shall be as manufactured by:

1. Thomas and Betts, Memphis, TN;
2. Or approved equal.

U. Terminal blocks shall be as manufactured by:

1. Allen-Bradley Company, Milwaukee, WI;
2. General Electric Company, Fairfield, CT;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Rigid Galvanized Steel Conduit

1. The Contractor shall provide rigid steel conduit. All steel conduit shall comply with the requirements of ANSI C80.1, and UL 6.
2. Both the inside and outside surfaces of the rigid steel conduit shall be protected against corrosion by a coating of zinc applied by the hot-dip galvanizing process.
3. Conduits, elbows, and couplings shall be rigid, heavy wall, mild steel, hot dip galvanized. Conduits, elbows, and couplings shall have a smooth interior with tapered threads and carefully reamed ends. Conduit size shall be 3/4-inch minimum and shall conform to UL 6.

4. Conduits, elbows, and couplings shall include a PVC coating for all outdoor, wet, and/or corrosive areas. For conduits located indoors in dry, dusty areas, the use of rigid galvanized steel conduit without PVC coating shall be permitted.

5. PVC coating of conduit shall be factory applied and shall include a smooth 2 mil thick urethane interior coating and 40 mil thick polyvinyl chloride exterior coating. PVC coated conduit shall conform to NEMA RN-1, ASTM D870, ASTM D1735, ETL-PVC 001, and UL 6. The exterior PVC coating color shall be gray and listed UL DYJC. The threads of conduits that have been cut in the field to size shall have the same PVC coating applied.

B. Hangers, Supports and Inserts

1. The Contractor shall provide hangers, supports and inserts for support of the electric conduit system. The supports shall securely attach the electric conduit system to the channel and structure.

2. The electric conduit system shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the New York City Building Code and the Uniform Building Code for Zone 2A application.

3. Transverse and longitudinal bracing shall be provided as required to brace the electric conduit for the seismic requirements specified.

4. All drilled in type concrete inserts shall be expansion shields or anchors conforming to Section 05 05 23.02 – Miscellaneous Metal Fastenings and 40 05 07 - Hangers and Supports for Process Piping. In corrosive and Class 1 and Division 1 locations, concrete inserts shall be Type 316 stainless steel.

5. Hangers and supports shall be in accordance with the requirements of Section 40 05 07 - Hangers and Supports for Process Piping except beam clamps, hanger rods and hardware shall be steel with electro-plated zinc finish, hot dipped galvanized or defender finish. This shall also include bolts, nuts and washers. In corrosive locations, hangers and support hardware shall be Type 316 stainless steel .

C. Flexible Metallic Conduit

1. The Contractor shall provide flexible metallic conduit where required to permit movement of connected devices and where it is impracticable to complete runs with rigid conduit subject to the limitations imposed by the NYCEC.

2. Flexible conduit used indoor in non-hazardous dry dusty areas shall be non-liquid-tight, with a steel core.

3. Flexible conduit used indoors/outdoors and in non-hazardous, wet and corrosive areas shall be UL Listed and include a hot dipped galvanized steel

core with a liquid-tight, polyvinyl chloride cover and shall include a built-in copper ground for sizes 3/4-inch through 1-1/4 inch.

4. For hazardous areas flexible conduit shall include a brass inner core with a bronze outer braid and protective neoprene plastic coating. End fittings shall be steel, brass or bronze.

D. Outlet Boxes and Fittings

1. The Contractor shall provide outlet boxes and fittings for rigid and flexible conduits. The outlet boxes and fittings required for the work which constitutes a part of the conduit system, shall be of approved types.

2. Fittings, bodies, and boxes installed on PVC coated conduits shall have interior and exterior PVC coatings equivalent and corresponding to that of the conduit on which they are installed and shall be NEMA 4X rated.

3. For outdoor, wet, and corrosive areas, conduit fittings and outlet bodies shall be Type 316 stainless steel. All units shall be gasketed, watertight, and threaded with five full threads and shall have rust-proofing in accordance with the requirements of this Section.

4. Threaded cast ferrous metal, hub type outlet boxes shall be used throughout, except in the interior walls of superstructures and in roof slabs protected by built-up roofing where pressed steel boxes shall be installed. Cast iron or alloy outlet boxes of the proper size and depths for the application, complete with watertight gaskets and covers secured by brass screws, shall be furnished and installed as indicated on the Contract Drawings or as required by the conduit run. Outlet boxes, furnished and installed for the installation of lighting fixtures, switches, and receptacles in a future contract, shall be furnished with watertight gaskets and blank covers.

5. For non-hazardous, indoor dry dusty areas pressed steel boxes of the proper size and depths for the application shall be provided. Boxes shall be rated NEMA 12, not less than No. 14 U.S. Standard Gauge (0.078 inch). The conduit openings shall be provided with oil-resistant gaskets. Conduits shall be fastened to these boxes with locknuts and bushings, and all unused outlets or holes shall be left sealed.

6. All outlet boxes intended for the support of fixtures shall be provided with approved fixture studs.

7. For concealed conduit runs in outside walls and all exposed conduit work, connections to boxes and fittings shall be made through threaded holes, unless otherwise approved by the Engineer. For concealed conduit work in non-hazardous areas other than outside walls, connections between conduits and boxes may be made with drilled holes, using locknuts and bushings.

8. Where necessary unions may be used.

   a. In non-hazardous locations unions shall be universal or Erickson

b. In hazardous locations unions shall be of type UNF, UNL or YNY.

9. All boxes installed for concealed conduits shall be provided with extension rings or plaster rings and covers as required. For non-hazardous, dry, indoor areas, stainless Type 316, satin beveled steel cover and device plates for surface mounted boxes shall be used. For corrosive locations, galvanized ferrous and galvanized cast ferrous metal cover and device plates with neoprene gaskets shall be used.

10. Outlet boxes and fittings installed on PVC coated conduit shall be Type 316 stainless steel. Dissimilar metals shall be avoided.

E. Conduit Accessories

1. The Contractor shall provide conduit accessories for use with the conduit system. The conduit accessories shall be of approved types.

2. Expansion and Deflection Fittings:

a. Expansion and deflection fittings shall be made up of non-corrodible parts and shall provide for ample longitudinal and lateral movement. A suitable bond shall provide a low resistance, continuous longitudinal path for ground currents.

b. Expansion and deflection fittings shall be watertight Type 316 stainless steel. Fittings shall be corrosion-resistant, UL listed and compatible with the conduit system.

c. Expansion /deflection fittings shall provide both expansion and deflection in a single fitting in accordance with the following:

1) Axial expansion or contraction up to 3/4-inch.

2) Angular misalignment up to 30 degrees.

3) Parallel misalignment up to 3/4-inch.

4) Expansion fittings shall provide expansion /contraction with eight-inch total movement.

3. Sealing Fittings:

a. Sealing fittings shall be Type 316 stainless steel.

b. Sealing fittings shall have an ample opening with threaded closure for access to conduit hub for making dam. Sealing fiber and compound shall be suitable for use with the fitting and shall be the products of the fitting manufacturer.

c. For corrosive locations, seal fittings shall include interior and exterior coatings equivalent to the PVC conduit coating specified under this Section. Dissimilar metals shall be avoided.

4. Drain Fittings:

a. Drain fittings shall be a combination device designed to provide ventilation to minimize condensation and drains accumulated condensate.

b. The combination drain/breather fitting shall be 3/8 inch male thread size with Type 316 stainless steel body.

5. Conduit Hubs:

a. Conduit hubs shall be threaded, insulated throat type with bonding screw locknut.

b. The conduit hub and locknut shall be Type 316 stainless steel and shall include a 90-degrees Celsius insulating surface and a sealing ring for a water-tight and dust-tight connection. Dissimilar metals shall be avoided.

6. Conduit Bushings:

a. Conduit bushings shall be insulated, grounding type with lay-in-lug connection. Two locknuts shall be provided for each bushing.

b. The conduit bushing and locknuts shall be Type 316 stainless steel. The bushing shall include a 90 degrees Celsius insulating surface.

7. Duct Seal:

a. Duct seal shall be a suitable for forming a water and gas tight seal between cables and conduits.

b. Completed seal shall be resistant to gasoline, oils, dilute acids, and bases.

c. The completed seal shall be capable of blocking water pressure of at least 10 psi.

8. Thruwall Seals and Bushings:

a. New Construction

1) WSK and WCSC type thruwall seals shall be used for conduits and cables passing through exterior subsurface walls and exterior concrete walls.

2) CSMI type seal bushings at the inside and CSMC type seal bushings at the outside of the structure in the same core bit-drilled hole shall be used for conduits passing through interior concrete wall, interior floors, interior block walls, exterior block walls, exterior subsurface walls, exterior concrete walls, floor slabs.

3) CFS and or CFSI type fire stop fittings shall be used for conduits passing through fire rated floors and walls.

4) TW type thru wall type barriers shall be use for multiple conduit runs passing through interior or exterior and fire rated walls.

b. Existing Construction

1) SK and FSCS type seals shall be used for conduits and cables passing through concrete floors and floor slabs.

2) CSMI type seal bushings at the inside and CSMC type seal bushings at the outside of the structure in the same core bit-drilled hole shall be used for conduits passing through interior concrete wall, interior floors, interior block walls, exterior block walls, exterior subsurface walls, exterior concrete walls, and floor slabs.

3) CFS and or CFSI type fire stop fittings shall be used for conduits passing through fire-rated floors and walls.

4) TW type through wall type barriers shall be used for multiple conduit runs which pass through interior or exterior and fire-rated walls.

9. Conduit Tags:

a. Conduit tags shall be 19 gauge, 1-1/2-inch diameter round brass which shall be secured to the conduit with annealed brass wire.

b. Conduit tags shall be clearly stamped with the conduit number in conformity with the conduit and cable schedule or as directed by the Engineer.

10. Conduit Markers:

a. Conduit identification markers shall be self-sticking color-coded tape. Identification tape shall be two inches wide and colored in accordance with the color banding specified under this Section.

F. Terminal, Junction and Pull Boxes.

1. The Contractor shall provide terminal, junction and pull boxes as shown on the Contract Drawings and where otherwise required, or as directed by the Engineer.

2. Boxes located indoor in dry, dusty areas shall be NEMA Type 12, constructed of welded and galvanized sheet steel. Boxes of dimensions 24 inches and less shall be 14 USS standard gauge metal. Boxes of dimensions greater than 24 shall be 12 USS standard gauge metal, except 10 USS standard gauge shall be used for boxes with any dimension of 36 inches or more. Boxes located in other areas shall conform to the following area classifications:

a. For wet locations, boxes shall be watertight NEMA Type 4 X. Boxes shall be constructed of stainless steel and shall include gasketed, bolt on covers, with tapped holes in bosses or hubs for conduit entrance. Boxes shall be provided with cast mounting lugs for installation in concrete.

b. For hazardous locations boxes shall be explosion proof NEMA Type 7. Boxes shall be constructed of cast iron and shall include threaded connections and ground joint surfaces.

c. For corrosive locations boxes shall be corrosion resistant, NEMA Type 4X. Boxes shall be constructed of Type 316 stainless steel material with sealed seams.

3. Pull and junction boxes shall be provided with covers held in place by brass screws. Terminal boxes shall be provided with terminal block supports and approved hinged covers fitted tightly against a gasket and secured by lug bolts and wing nuts. Hinges, lug bolts, wing nuts and other fittings shall be made of an approved, non-ferrous, non-corrodible metal. All boxes shall be provided with rabbeted gaskets or flange gaskets securely held in place.

4. Tapping for threaded connections to outlet boxes, junction boxes, pull boxes and conduit fittings in non-explosion proof construction shall conform to the following:

a. All threads shall be tapered.

b. If threads for connection of conduit are tapped all the way through a hole in an enclosure, or if an equivalent construction is employed, there shall be not less than 3-1/2 threads in the metal and the construction of the enclosure shall be such that a suitable conduit bushing can be properly attached.

c. If threads for connections of conduit are not all the way through a hole in a box wall, conduit hub or the like, there shall be not less than five full threads in the metal and there shall be a smooth, well rounded inlet hole for the conductors, which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit. The threaded hole shall be provided with a conduit end stop.

d. Tapping for threaded connections for explosion proof construction shall conform to the requirements of the NYCEC for construction in Class I, Division 1, and hazardous locations.

5. Cast iron or cast ferrous alloy outlet boxes, junction boxes, pull boxes, conduit fittings and conduit accessories such as box covers shall be rust-proofed by zinc coating applied by the "hot-dip" process or shall be given a rust protective coating applied by either of the following methods:

a. Method A:

1) Castings shall be given a mechanical and chemical cleaning.

2) Castings shall be given a phosphoric acid type dip.

3) Then a coating of zinc chromate primer shall be applied, and finally

4) A coating of baked enamel finish shall be applied over the outside and inside surfaces of the castings.

b. Method B:

1) Castings shall be given a mechanical and chemical cleaning.

2) Then a coating of cadmium shall be deposited electrolytically.

3) Then a coating of zinc shall be applied by electroplating.

4) Then a vinyl resin base aluminum lacquer shall be applied.

6. Stamped steel outlet boxes, junction boxes and box covers shall be rust-proofed by a zinc coating applied by an electro-galvanizing or sherardizing process. Fabricated sheet steel boxes shall be formed from galvanized sheet steel. Welded joints shall be touched up with aluminum lacquer and boxes and covers shall be given a shop priming coat of zinc chromate rust inhibiting paint.

7. Terminal blocks shall be used within terminal boxes for termination of prepared conductors No. 10 AWG and smaller. Terminal blocks shall be in accordance with the following:

a. Terminal blocks shall be high density, screw terminal type suitable for rail mounting with quantities sufficient for the conductors to be terminated plus 20 percent spare.

b. Terminal blocks shall be NEMA rated, 600 volt, 35 ampere suitable for 85 degrees C.

c. Terminal block components shall have stainless steel and tin plated copper alloy components, backed out captive screws and marking surface.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. All conduits shall be installed in accordance with the requirements specified under this Section and in conformity with the sizes stated in the Contract Documents. They shall be installed complete with all accessories, fittings, and boxes, in an approved and workmanlike manner so as to provide proper raceways for electrical conductors.

B. The Contractor's attention is called to the fact that all conduit runs indicated on the Contract Drawings are shown diagrammatically for the purpose of outlining the general method of routing the conduits to avoid interference. Where conduit runs are not shown, it shall be the responsibility of the Contractor to establish the runs required based upon the various systems shown on the Contract Drawings.

C. Should any structural difficulties prevent the setting of cabinets, boxes, conduits, etc., at points shown on the plans, deviations therefrom as determined by the Engineer will be permitted and shall be made without additional cost.

D. All exposed steel conduits, fittings, boxes, straps, racks and hangers shall be painted in conformity with Section 09 91 00 – Painting. PVC coated conduit systems shall not be painted. Paint shall match the gray color of the PVC coated conduits.

E. Conduits shall be tagged using conduit tags. Conduit tags shall be installed where conduits terminate in equipment and enclosures.

F. Exposed conduits shall be color banded using conduit markers. Markers shall also include operating voltage when over 600 volts. Conduit markers shall be installed 360 degrees, double wrapped around conduit exteriors. Conduit markers shall be installed where conduits enter equipment, boxes, within each room, at wall penetrations and 50 feet on centers in each area. When exposed conduits are to be painted, markers shall be installed after the conduits are painted. Color banding shall be in accordance with the following:

1. 120/208 volt AC: Gray.
2. 277/480 volt or 480 volt AC: Sand.
3. 4160 volt AC: Silver.
4. 13800 volt AC: Brown.
5. Fire Detection and Alarm: Red.
6. Telephone: Blue.
7. Intercommunication: Yellow.
8. Security System: Rust.
9. Low Voltage Switching, Instrumentation and Controls System: Black.

G. All enclosing cases, including condulets and conduit bodies, for fire, sprinkler, smoke detection, and associated systems' alarm apparatus and equipment shall be

painted or colored Fire Department "RED", in accordance with New York City Building Code, unless otherwise required by the local Authority Having Jurisdiction (AHJ).

3.02 INSTALLATION

A. Installation of Raceways

1. The Contractor shall install all exposed raceways parallel or at right angles to walls and ceiling beams. Changes in directions shall be made with bends, elbows, and pull boxes. All parallel runs shall be spaced uniformly throughout and secured in place with hangers and fasteners. Brace raceways to satisfy the specified seismic requirements in accordance with the restraint details.

2. Conduits, where exposed, shall in all cases be substantially supported in an approved manner, but they shall not be fastened to or come in contact with any other pipes, ducts, or other work of a similar nature. In all exposed work, approved channel or angle iron hangers, racks, one-hole straps, or a combination thereof shall be provided to support the conduits. Where conduits are supported with one-hole straps, spacers shall be used to provide 1/4-inch minimum clearance between the conduits and walls or ceilings.

3. Hanger rods for trapeze type hangers shall be not less than 3/8 inch diameter. Conduit supports shall be located at intervals not exceeding 8 feet. Conduits shall be securely fastened to each support with U-bolts, straps or clamps.

4. All concealed conduits shall be placed in walls, floors, ceilings or slabs at the proper time in accordance with the progress of the structural Work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural Work unnecessarily.

5. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during the pouring of concrete. The Contractor will be held responsible for proper position of conduits and shall rearrange any conduit that may be displaced while concrete is poured, without additional cost.

6. Where conduit runs are to be concealed and the Contractor fails to place such conduit in sufficient time to be included in the structures, and the structures are completed without such conduit, the Contractor shall install such runs either concealed or exposed as directed by the Engineer, with no extra payment for additional Work or for more conduit than the original lengths.

7. Embedded conduits shall be run in structural concrete in the center of slabs and walls and above waterstops. Conduit connections shall be made watertight. Contractor shall confirm that concrete thickness is sufficient for embedding the quantity of conduits intended. Unless specifically shown

otherwise on the Contract Documents, embedded conduits shall be in accordance with the following criteria:

a. Minimum concrete thickness shall be as follows:

1) For concrete 16 inches thick and less, the minimum concrete thickness shall be 11.5 inches plus the depth of the largest conduit assembly. The conduit assembly depth shall be from the top of the uppermost conduit to the bottom of the lowest conduit.

2) For concrete greater than 16 inches thick, the minimum concrete thickness shall be 13.5 inches plus the depth of the largest conduit assembly.

3) For concrete at foundation slabs, an additional inch shall be added to the minimum concrete thicknesses previously stated.

b. Conduit spacing shall be as follows:

1) Conduits shall be separated three times outer diameter of larger conduit center to center.

2) For multiple conduit layer assemblies, conduits shall be separated vertically, three times the outer diameter of the larger conduit center to center.

3) When conduits cross at a given point, the conduits may be in direct contact and the angle of cross shall be 45 degrees or greater. Conduits may also cross within the vertical spacing of a multi-conduit layer assembly.

4) When conduits cross a structural expansion joint, conduits shall be separated three times the outer diameter of the larger conduit fitting center to center.

8. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three quarter bends, including those bends located immediately at the outlet or fitting.

9. Factory-made conduit bends or elbows shall be used wherever possible in making necessary changes in direction. Field bends shall be carefully made so as to prevent conduit damage or reduction in the internal areas. The radius shall not be less than six times the nominal diameters for the conduit with carefully matched bends on parallel runs so as to present a neat appearance.

10. All conduits, where cut, shall be carefully reamed to remove burrs. No running threads will be permitted. All screw joints shall be watertight. Conduits shall be fitted in an approved manner to all devices and boxes.

The ends of all conduits shall be equipped with suitable approved conduit fittings. The ends of all empty conduits shall stub up six inches above the slab and shall be capped.

11. As far as practicable, conduits shall be pitched to drain to outlet boxes or otherwise so installed as to avoid trapping moisture. Trapped conduits in concealed construction shall be provided with outlet boxes for drainage. Where necessary drainage in outlet boxes or where dips are unavoidable in exposed conduits, a drain fitting shall be installed at the low point.

12. Thruwall type seals and conduit sealing bushings shall be installed for all conduits passing through concrete slabs, floors, walls, or block walls.

13. Conduit runs shall be installed so as to avoid flues, heat sources, and steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water, steam pipes, or heat sources.

14. Where conduit enters or leaves equipment located within electrical and control rooms, the conduit shall be sealed and packed with a suitable duct seal compound.

15. A 250-pound tested polyethylene pull tape shall be provided in all empty conduits, with a minimum eight inches of slack, double backed into the conduit. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings designed for this purpose at each end. Discs shall not be removed until it is necessary to clean the conduit.

16. All conduits that are cut on the job shall be cut square and taper reamed to remove burrs before installation. Where steel conduit is cut and threaded on the Site, it shall be coated before and after making connections.

17. PVC coated conduits shall be installed in compliance with the latest version of the National Electrical Code and other applicable codes and standards as indicated in these specifications.

18. PVC coated conduit shall be installed in accordance with NECA National Electrical Installation Standards (NEIS) 101. Standards for installing steel conduit.

19. Conduits embedded in concrete shall stub up six inches above the slab. A three-inch-high curb extending three inches from the outer surface of the conduit penetrating the floor shall be provided to prevent corrosion. Conduit stub-ups shall be terminated in couplings, slightly above the finished concrete curb.

B. Conduit Connections to Equipment.

1. At each motor, limit switch, solenoid valve, electrical control device, or other electrically controlled or operated equipment, the Contractor shall

install a complete conduit connection between the conduit system and the terminal box of the motor or the conduit connection point of the equipment.

2. Conduits installed in the conduit system shall be terminated in such locations so as to permit direct connections to motors, devices, or equipment.

3. Connections shall be made with rigid conduits if equipment is fixed and not subject to adjustment, mechanical movement, or vibration. Rigid connections shall be provided with union fittings to permit removal of equipment without cutting, breaking, or burning conduit.

4. Motors, transformers, and equipment subject to adjustment, mechanical movement, or vibration shall be connected with flexible metallic conduit.

5. Devices such as solenoid valves, small limit switches, etc., shall be connected with flexible metallic conduits arranged to prevent strain and distortion.

6. Flexible conduit connections shall be watertight unless the area of installation requires explosion-proof construction.

C. Installation of Boxes and Fittings.

1. All concealed outlet boxes shall be set in such a manner that they will be plumb and flush with the finished surface.

2. Boxes shall be installed rigidly and securely to the structure. Independent supports shall be provided where no walls or other structural surface exists.

3. Expansion and expansion/deflection fittings shall be installed where conduits cross structural expansion joints and at locations shown on the Contract Drawings. Fittings shall be installed on each conduit and incorporated into the expansion joints of structures, at right angles to the joint, to insure their proper functioning and preservation.

4. Expansion fittings shall be installed on exposed conduit runs exceeding 200 feet. Unless specifically shown otherwise on the Contract Documents, when crossing structural expansion joints larger than one inch, an expansion fitting shall also be installed together with an expansion/deflection fitting. The fittings shall be installed on each conduit run in accordance with manufacture's recommendations to provide the additional movement necessary.

5. All conduit connections in wet and corrosive locations shall be made up watertight and shall terminate at enclosures with an approved conduit hubs.

6. All conduit connections in dry and dusty locations shall terminate at enclosures with bushings and lock nuts. Terminations shall include one bushing and two lock nuts at each location. Lock nuts shall be installed one inside and one lock nut outside the enclosure. All conduits shall be bonded to the safety ground.

7. At pull and junction boxes having any box dimension in excess of 18 inches, jumper type grounding bushings shall be installed on conduit ends and jumper wires shall be installed to bond all conduits and to bond conduits to boxes.

8. All insulated grounding bushings shall be bonded together and to the structure of the enclosure by a continuous, copper bonding wire.

9. Removable, flame-retardant, insulating cable supports shall be provided in all boxes with any dimension exceeding three feet.

10. Scratched PVC coated boxes and fittings damaged as a result of installation work shall be touched up by field applying PVC coatings. All touch up work shall be in strict conformance with manufacturer's recommendations.

D. Installation within Hazardous Areas.

1. Explosion-proof boxes and fittings shall be of a type approved by the Engineer. Boxes and fittings shall be of cast iron with finish as specified hereinbefore or of an aluminum alloy specially developed for use in hazardous areas.

2. Explosion-proof boxes shall be suitable for the installation of explosion-proof switches, receptacles, lighting fixtures, or other devices as indicated. All conduit connections to such boxes shall be made with threaded fittings. Bushings and locknut connections shall not be used.

3. Conduits terminating at explosion-proof boxes and enclosing circuit opening equipment shall be sealed at the entrance to the box with an approved compound-filled sealing fitting to prevent passage of explosive or combustible gases through the conduit. Where construction prevents the use of sealing fittings, the ends of the conduits shall be properly sealed with sealing compound.

4. Sealing fittings shall be installed to seal each conduit leading from or entering into hazardous locations. Exposed conduits passing through hazardous locations shall be sealed at points of exit and entrance.

5. The installation of explosion-proof boxes, fittings, and all conduits in connection therewith shall conform to the requirements of the NYCEC for Class I, Division 1 Group D hazardous location.

3.03 FIELD TESTING / QUALITY CONTROL

A. After installation, the electric conduit system shall be field tested. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:

1. Each conduit shall be tested by pulling through a cylindrical mandrel as specified under this Section. Maintain a record of all conduits testing clear.

2. Conduit systems shall be ground tested in the presence of the Engineer, who will inspect all enclosures and pull and junction boxes for bonding to the

safety green conductor pulled with the nominal 120 volt and higher power and control circuits, and for bonding of the conduit grounding bushing to this safety ground.

3. The separation of above safety grounding system from the instrumentation signal grounding shall be verified.

4. The Contractor shall provide a Field Test Report. The Report shall identify the testing performed and the results obtained.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. All conduits shall be carefully cleaned before and after installation and all inside surfaces shall be free from all imperfections likely to injure the cable. Conduits shall be cleaned in accordance with the following:

1. After erection of complete conduit runs, conduits shall be snaked with a suitable swab to which shall be attached an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit.

2. All conduits through which the mandrel will not pass shall be removed and replaced by the Contractor at its own expense.

3. After snaking, the ends of the dead-ended conduits shall be protected with standard malleable iron caps to prevent the entrance of water or other foreign matter.

4. Conduit ends shall be protected after cleaning with caps to prevent entrance of water, concrete, debris or other foreign substance.

END OF SECTION

SECTION 26 05 43 – UNDERGROUND DUCTS, MANHOLES AND RACEWAYS FOR ELECTRICAL SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing underground ducts, electric manholes, and raceways for electrical systems.

1. This Section also includes requirements for providing electric handholes.

2. Underground ducts, electric manholes, electric handholes, and raceways shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

3. Underground ducts shall be concrete-encased. The Contractor shall provide reinforced concrete encasement for the duct system.

B. The Contractor shall perform all excavations, complete all forms, and do backfilling and tamping, as required, unless specifically shown otherwise on the Contract Documents.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 03 21 00 - Reinforcing Steel

C. Section 05 05 23.02 - Miscellaneous Metal Fastenings

D. Section 05 12 00 - Structural Steel Framing

E. Section 26 05 27 - Grounding

F. Section 26 05 33 - Raceways and Boxes for Electrical Systems

G. Section 31 23 16 - Excavation

H. Section 31 23 23 - Fill

1.04 REFERENCES

A. Definitions

1. All references to the Utility or Electric Utility shall refer Consolidated Edison Company of New York or the Local Electric Utility Having Jurisdiction.

B. Reference Standards

1. Underground ducts, electric manholes, handholes and raceways shall comply with the latest applicable provisions and recommendations of the following:

a.	NEMA TC2	-	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
b.	NESC	-	National Electrical Safety Code
c.	NYCEC	-	New York City Electrical Code
d.	UL 651	-	UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
e.	UL 2420	-	UL Standard for Safety Below ground Reinforced Thermosetting Resin conduit (RTRC) and Fittings.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited, to:

1. A list of proposed manufacturers with the products they produce proposed for the Contract.

2. Manufacturer's technical information with name, designation, and catalog number for all products for the underground ducts systems, manholes, handholes, raceways, and accessories proposed for use.

3. Drawings showing interior and exterior dimensions and details of openings, jointing, inserts, and reinforcing.

4. Scaled Shop Drawings showing the routing of the duct banks and the location of manholes, handholes, and the principal outline of buildings and structures. Reference duct banks dimensionally from fixed objects or structures. Include profiles of duct banks showing crossings with piping and other underground systems.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Underground ducts, manholes, handholes, and raceways shall be delivered, stored, and handled in accordance with this Section, the Specifications, and the manufacturer's instructions.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Rigid Steel Conduit: See Section 26 05 33 - Raceway and Boxes for Electrical Systems.

B. PVC conduit shall be as manufactured by:

1. Allied Tube & Conduit, Harvey, IL.

2. Heritage Plastics, Harvey, IL.
3. Or approved equal.

C. Fiberglass-reinforced epoxy conduit shall be as manufactured by:
1. FRE Composites Northeast, Boston, MA.
2. Champion Fiberglass, Spring, TX.
3. Or approved equal.

D. Warning tape shall be as manufactured by:
1. Seton, Branford, CT.
2. Ideal Industries, Sycamore, IL.
3. Or approved equal.

E. Duct Seal: See Section 26 05 33 - Raceways and Boxes for Electrical Systems.

F. Reinforced Concrete: See Section 03 30 00 - Cast-in-Place Concrete and Section 03 21 00 – Reinforcing Steel.

G. Expansion and Deflection Fittings: See Section 26 05 33 - Raceways and Boxes for Electrical Systems.

H. Conduit Bushings: See Section 26 05 33 - Raceways and Boxes for Electrical Systems.

2.02 MATERIALS / EQUIPMENT

A. Rigid Steel Conduit
1. Rigid galvanized Steel conduit without a PVC coating shall be used for all ducts. Rigid Steel Conduit Rigid Steel Conduit shall be in accordance with the requirements of Section 26 05 33 - Raceways and Boxes for Electrical Systems.

B. Non-Metallic Conduit and Fittings
1. Non-metallic conduit for ducts where shown on the Contract Drawings shall be fiberglass-reinforced epoxy.
a. Reinforced thermosetting resin conduit and fittings shall conform to UL No. 2420. Both conduit and fittings shall consist of 68 percent glass content encapsulated in an epoxy matrix.
2. All non-metallic fittings, elbows, bodies, terminations, expansions, and fasteners shall be of the same material and manufacturer as the conduit.

C. Underground Duct Accessories and Fittings
1. Conduit Spacers

a. Factory fabricated conduit spacers shall be nonmetallic, vertical, and horizontal interlocking type to maintain spacing between conduits. Spacers shall be suitable for all types of conduit in multiple sizes.

2. Warning Ribbon

a. Warning ribbon shall be a three inch wide, four mil polyethylene or polyvinyl chloride detectable tape. The tape shall be permanently imprinted in red color, "CAUTION BURIED ELECTRIC LINE BELOW."

3. Duct Seal

a. Duct seal for conduits shall be in accordance with the requirements of Section 26 05 33 - Raceways and Boxes for Electrical Systems.

4. Reinforced Concrete

a. Concrete for envelope shall be in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete. Steel reinforcement shall be in accordance with the requirements of Section 05 12 00 - Structural Steel Framing.

5. Expansion and Deflection Fittings

a. Where specifically shown on the Contract Drawings, expansion and deflection fittings shall be provided at the structural joints of the underground duct system.

b. Expansion and deflection fittings shall be in accordance with Section 26 05 33 - Raceways and Boxes for Electrical Systems.

6. Conduit Bushings

a. Conduit bushings shall be provided for the termination of rigid steel conduits at each manhole.

b. Conduit bushings shall be in accordance with Section 26 05 33 - Raceways and Boxes for Electrical Systems.

D. Manholes and Handholes

1. Manholes and handholes shall be cast-in-place type of reinforced concrete. Where specifically shown on the Contract D Documents, the use of precast-type manholes and handholes shall be permitted.

2. Manholes associated with service feeders shall be in accordance with the requirements of the Utility.

3. Concrete for manholes and handholes shall be in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete. Manholes and handholes shall be constructed to withstand ground water pressure when completely submerged by rising water table.

4. Steel reinforcement shall be as shown on the details on the Contract Drawings and shall be in accordance with the requirements of Section 05 12 00 - Structural Framing.
5. Manholes and handholes shall have dimensions as shown on the Contract Drawings and shall be provided with all duct entrances sized and located to suit duct banks.
6. Concrete floor shall be sloped towards the drain sump at the center of each manhole and handhole.
7. All manhole and handhole hardware shall be hot-dipped galvanized steel.

E. Manhole and Handhole Accessories

1. Frames and Covers
   a. Each manhole and handhole shall be provided with a cast-iron watertight manhole frame with inside and outside covers.
   b. All frames and covers shall be in accordance with the requirements of Section 05 05 23.02 - Miscellaneous Metal Fastenings. Frames and covers shall be annealed, high quality, gray cast iron, and free from blowholes, sandholes, scabs, fins, scales, and other defects. They shall be uniform in form and dimensions, and shall be as approved by the Engineer.
   c. The frames shall be so set that the completed installation will provide a proper alignment of the outside covers with the roadways or other surrounding areas. Manhole and handhole covers shall fit the frame without undue play.
   d. The following words shall be cast in the top of all manhole and hand hole covers, as appropriate.
      1) “ELECTRIC POWER, LOW VOLTAGE”
      2) “ELECTRIC POWER, MEDIUM VOLTAGE”
      3) “COMMUNICATIONS / INSTRUMENTATION”
2. Cable Supports
   a. Manholes shall be furnished with cable racks, cable hooks, and insulators to effectively support all cables indicated for present and future installation.
      1) Cable racks shall be made from steel channel with ample strength to support cables. Racks shall be firmly anchored to walls.
      2) Cable hooks shall be made from malleable iron.
      3) Racks and hooks shall have hot-dipped galvanized finish.

4) Insulators shall be made of high-grade dry-process porcelain with smooth glazed surfaces and shall fit hooks in such manner as to prevent wobbling and ensure minimum movement.

3. Pulling Irons

a. Galvanized steel pulling irons shall be provided for each manhole and handhole. Pulling irons shall be cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.

4. Grounding

a. Each manhole shall be provided with a grounding system. The grounding system shall consist of ground rods and cables in accordance with the details shown on the Contract Drawings.

b. Ground rods and cable shall be in accordance with the requirements of Section 26 05 27 - Grounding.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Duct Banks

1. The duct system shall be installed to avoid interferences with structures, piping, and other underground systems. Conduit duct banks shall be sized, arranged, and installed in a reinforced concrete envelope as shown on the Contract Drawings.

2. Trenches for duct banks shall be in accordance with the requirements of Section 31 23 16 - Excavation. Duct bank trenches shall have the bottom tamped firmly and evenly, and suitably braced side forms shall be employed in forming the envelope.

3. Duct banks shall follow straight lines as far as possible. Where deviation from a straight line becomes necessary, offsets shall be made using five-degree angle coupling or make bend with sweeps. The sweep radius shall be 48 inches for 90 and 45-degree bends and 36 inches for 30-degree bends.

Where directed by the Engineer, bends shall be made up with standard factory bends or other approved curved sections.

4. Duct bank installations and penetrations through foundation walls shall be made watertight.

5. Duct banks shall be assembled using non-magnetic saddles, spacers, and separators. Separators shall be positioned to provide three-inch minimum concrete separation between the outer surfaces of the ducts.

6. Concrete coverings shall be provided on both sides, top and bottom of the concrete envelopes around conduits. Concrete coverings shall be in accordance with the detail shown on the Contract Drawings. Top of concrete encasement shall not be less than thirty inches below finish grade. Add red dye to concrete used for envelopes or trowel a coloring on the concrete for easy identification during subsequent excavation.

7. Before pouring concrete, written approval shall be obtained from the inspecting engineer.

8. Ducts shall be firmly fixed in place during pouring of concrete. Concrete shall be carefully spaded and vibrated to ensure filling of all spaces between ducts.

9. A transition shall be made from non-metallic to rigid galvanized steel conduit where duct banks enter structures or turn upward for continuation above grade. Rigid steel ducts shall be terminated using insulated grounding bushings. Ducts inside buildings shall be continued using rigid steel or PVC-coated rigid steel conduits as required for the area.

10. Ducts entering manholes and hand holes shall be terminated using suitable end bells. Rigid steel ducts shall be terminated using insulated grounding bushings.

11. Backfilling for duct banks shall be in accordance with the requirements of Section 31 23 23 - Fill. Backfilling shall be permitted when directed by the Engineer to proceed. Backfilling shall not be with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

12. Duct runs shall be sloped for drainage toward manholes and away from buildings with a slope of approximately three inches per 100 feet.

13. A ground cable shall be installed in each duct bank envelope. Cable shall be in accordance with the requirements of Section 26 05 27 - Grounding. The ground shall be made electrically continuous throughout the entire duct bank system. Ground cable shall be connected to the building, station ground grid, equipment ground buses, and to each conduit grounding bushing of the underground duct system. The ground cable shall be terminated at the last manhole or handhole for outlying structures.

14. A warning ribbon shall be installed approximately 12 inches below finished grade over all underground duct banks carrying cables of 480 volts and higher.

15. All ducts entering buildings and structures shall be sealed. All empty spare ducts shall be sealed and plugged.

16. An expansion and deflection fitting shall be installed on each conduit at each of the structural expansion joints when shown on the Contract Drawings. Joints shall be located as defined by the criteria noted on the Contract Drawings.

B. Manholes and Handholes

1. Manholes and handholes shall be installed where shown on the Contract Drawings. Place each manhole and handhole on a 12-inch crushed-stone base and make level.

2. Manhole and handhole excavation shall be in accordance with the requirements of Section 31 23 16 - Excavation. Backfilling for manholes and handholes shall be in accordance with the requirements of Section 31 23 23 - Fill.

3. Manhole and handhole installation shall be completed so that structure is watertight. All penetrations through manhole walls and bottoms to facilitate equipment such as ground rods shall be made through cast-in-place sleeves. Sleeves shall be made watertight after the installation of equipment. Two coats of bituminous waterproofing material shall be applied to the exterior surface of each manhole and handhole. A waterproof gasket shall be provided all around removable precast manhole cap.

4. Cable racks shall be installed within each manhole for the support of cables. Cable racks shall be in accordance with the following:

   a. Attach racks with three-inch by 3/8-inch diameter tamp-in studs mounted in one-inch holes drilled into walls of manholes in the absence of inserts. Apply PVC coating to all racks.

   b. Provide cable hooks to support each cable on each rack along the cable run within the manholes. Apply PVC coating to all hooks.

   c. Individually support each cable at each hook on porcelain insulators. Provide sufficient slack for each cable.

   d. In the manhole securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non-metallic 3/4-inch strapping tape as manufactured by 3M or tie down with nylon straps.

5. A grounding system shall be installed for each manhole. All exposed metal, manhole frame and cover, accessories and the concrete reinforcing rods shall be bonded with No. 4 AWG minimum bare copper wire and connected

to the duct bank ground in accordance with the details shown on the Contract Drawings.

6. Concrete curb shall be provided for manholes when required to adjust manhole cover to proper grade. Curb shall be constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the curb shall be such as is necessary to bring the manhole frame to the proper grade.

7. For cast-in-place type manholes and handholes, pulling irons shall be set and other built-in items shall be in place before placing concrete.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning and Protection

1. After installation, each conduit in each duct bank shall be cleaned and cleared of obstructions and foreign matter by rodding and by the passage of cleaning brushes or cutting mandrels.

2. After cleaning, the clearance of each conduit shall be checked by passing a 12-inch-long mandrel, of diameter 1/2 inch less than the nominal duct diameter, through the entire length of duct run. Ducts which do not permit passage of the mandrel shall be cleared, cut out, and replaced or sealed and replaced by additional construction. The duct bank conduit cleaning shall be included in the electric conduit system field test report specified in Section 26 05 33 - Raceways and Boxes for Electrical Systems.

END OF SECTION

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install, test and place into satisfactory operation Vibration and Seismic Controls (V&SCs) for Electrical Systems complete with all auxiliary equipment per the Contract Documents and this Section.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	16
2.04	Source Quality Control / Shop Tests	17
PART 3	EXECUTION	17
3.01	Examination / Preparation	17
3.02	Installation	17
3.03	Field Testing / Quality Control	19
3.04	Startup / Demonstration	20
3.05	Adjusting / Protection / Cleanup	21

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 - Painting

1.04 REFERENCES

A. Definitions

1. All references to the Electric Utility or the Utility shall mean the Local Electric Utility having jurisdiction.
2. The Electric Utility is Con Edison.
3. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation at less than 1000 volts and within the 600 V Class.
4. Medium-voltage as used in this Section shall mean all equipment, conductors, insulation systems, and accessories intended for operation above 1000 volts and below 99,000 volts.

B. Seismic Restraint as used in this Section and the Contract Documents shall mean a fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical and horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. VISCMA as used in this Section and the Contract Documents shall mean the Vibration Isolation and Seismic Control Manufacturers Association.

D. Reference Standards

1.	ASCE 7-10	-	Minimum Design Loads for Buildings and Other Structures
2.	FEMA 413	-	Installing Seismic Restraints for Electrical Equipment.
3.	MISR Guide	-	Mason Industries Seismic Restraint Guidelines.
4.	RS 9-6	-	NYCBC 1968 Reference Standard RS 9-6 Earthquake Loads.
5.	NYCBC 1613	-	NYCBC Section 1613 - Earthquake Loads
6.	NYCEAB	-	New York City Electrical Advisory Board
7.	NYCBC	-	New York City Building Code.
8.	NYCEC	-	New York City Electrical Code.

1.05 DESCRIPTION

A. The Contractor shall provide fully functional vibration and seismic controls for equipment installed under Divisions 26, 27, and 28.

B. The devices selected for vibration control or isolation for electrical system shall not transmit the vibrations to the building structure or foundations supporting building structure under normal operation.

C. The devices selected for seismic restraints or control should enable electrical equipment, conduits, components etc. to resist seismic forces by the strength of their attachment to the building structure or move with the building structure and remain intact and functioning during and after an earthquake.

D. Equipment subject to requirement for vibration or seismic restraints includes but is not restricted to battery racks, bus ducts, cable trays, conduits, switchgear, generators, transformers, unit substations, motor control centers, variable speed drives, and lighting fixtures.

E. Vibrations Control Devices (VCDs)

1. Provide vibration isolators, base frames, and inertia bases of sufficient size and design to assure that deflection and stability requirements as specified in this Section are met.
2. Isolators shall be provided to deflect uniformly under operating loads.
3. Steel springs shall be selected to perform their function without undue stress or overloading.
4. All isolators shall have a minimum ¼" thick elastomeric or fiber glass acoustical pad within the vertical load path.
5. Stable steel springs shall be designed to operate in the linear portion of their load versus deflection curve and must be linear over a deflection range of not less than 50 percent above the specified deflection.
    a. The ratio of lateral to vertical stiffness shall be not less than 0.8.
    b. The designed deflection of each spring must be at least 75% of specified deflection of the spring.
6. Where detailed in this Section, the equipment Section, or shown on the Contract Drawings, all structural steel bases supporting vibration isolated equipment, including concrete filled inertia bases, shall be designed and fabricated by the vibration isolation manufacturer.
    a. Unless otherwise noted in the Contract Documents, all equipment mounted on vibration-isolated bases shall have a minimum operating clearance of two inches between the base and floor or support beneath.

F. Seismic Control Devices (SCDs)

1. All seismic restraint devices shall meet the following minimum requirements:
    a. The snubber/restrained isolator for isolated equipment shall include a resilient element that will ensure that no un-cushioned shock can occur (excluding cable restraints).
    b. It shall be possible to visually inspect the resilient snubbing material for damage and allow for replacement, if necessary.
    c. All snubbers to include a maximum air gap of 0.25" (6mm).
    d. Seismic restraint devices and systems shall be designed to offer seismic restraint in all directions.

e. Seismic restraint capacities shall be verified by one of the following methods:

1) A Nationally Recognized Testing Laboratory (NRTL).

2) Certified by a registered Professional Engineer licensed in the State of New York.

3) By a nationally recognized agency, such as VISCMA, that has reviewed and approved the restraint.

2. Seismic restraint manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers/restraints to both the equipment and supporting structure on vibration-isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

3. The Contractor shall furnish to the seismic restraint manufacturer a complete set of approved Shop Drawings of all equipment which is to be restrained, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed.

a. The Shop Drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, and installed operating weights of the equipment to be restrained.

4. All conduit, busway, and cable trays piping and ductwork shall meet the requirement of NYCEC.

a. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various restraint sizes and anchors, as well as ‘worst case’ reaction loads for each restraint and/or anchor size.

5. The Contractor shall ensure that all housekeeping pads are adequately reinforced and are properly dowelled to the building structure, so as to withstand calculated seismic forces.

a. In addition, the size of the housekeeping pad shall be coordinated with the seismic restraint manufacturer to ensure that adequate edge distances exist in order to obtain desired equipment anchor capacities.

1.06 QUALITY ASSURANCE

A. The V&SC manufacturer shall be the manufacturer of all the major components of V&SC devices and assemblies.

B. The manufacturer of the V&SCs shall have produced V&SCs for a minimum period for the last fifteen (15) years.

1. The Contractor shall provide a list of at least five (5) installations with similar equipment, which will be provided under this Contract, and demonstrate compliance with these requirements.
2. The Contractor will provide the name, address, telephone number, and email of the Company representative who can speak to inquires in relation to the procurement, installation, commissioning, and operation of the equipment at the above listed five installations.

C. V&SCs shall comply with and be installed in accordance with NYCBC 1613.

D. V&SC devices shall have the manufacturer's name, part number, and material heat code stamped in the devices themselves.

E. Independent testing agencies for V&SCs shall have 15 or more years conducting tests on V&SCs.

F. Calculations in relation to V&SCs shall be made by a Registered Professional Engineer in New York State who has five or more years of experience in providing vibration and seismic control calculations.

G. V&SC manufacturer shall be responsible for the selection of the attachment hardware as required to attach V&SC devices to both the equipment and supporting structure.

H. The requirements for V&SC in this Section are in addition to other requirements as specified elsewhere in the equipment Sections for the support and attachment of equipment and electrical services, and for the isolation of the same equipment.

I. Nothing on the Contract Documents shall be interpreted as justification to waive the requirements of this Section.

J. The Contractor shall furnish to the V&SC manufacturer a complete set of approved Shop Drawings of all equipment to which V&SCs are to be provided.

1. From these drawings, the selection and design of devices and/or attachment hardware will be completed.
2. The Shop Drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, and installed operating weights of the equipment to which control systems or devices are to be applied.

K. Contractor shall coordinate with the V&SC manufacture the size of all housekeeping pads supporting equipment.

L. Contractor shall coordinate with V&SC manufacturer, equipment manufacturer and structural engineer to locate and size structural supports underneath equipment.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer.

B. Submittals shall include, but not be limited to, the following:

1. Catalog cuts on all V&SC devices detailing compliance with this Section.
2. Detailed schedules of flexible and rigidly mounted equipment.
3. Fabrication details for all equipment bases including dimensions, structural member sizes, and support point locations.
4. All details of suspension and support for ceiling hung equipment.
5. Restraint and anchorage calculations for all V&SC devices.
6. Certified copy of the manufacturer's Design Tests made in accordance with and conducted on V&SC devices and type that is being offered for this Contract.
7. Certified dimensioned outline drawings showing equipment layouts, front view, and floor plan in sufficient detail to define space required for dismantling and maintenance, exact location of and space available, and the interrelationship of the various components.
8. Cross sections and details, as required, to satisfy the Engineer, that all components conform to specification requirements, including design and physical arrangement.
9. All information required by the Engineer for the design and location of all connecting structural, mechanical, or electrical items such as piping, ducts, cables, conduits, etc.
10. Weight of the equipment and distribution on the foundation support of the static, impact, seismic, wind, and other loads.
11. Erection drawings.
12. Complete Bill of Material.
13. Details of special features.
14. Nameplate schedules.
15. Recommended spare parts list with pricing.
16. List of Special Tools.
17. Painting Procedures.
18. List of recommended lubricants.
19. Preliminary Operation and Maintenance manuals.
20. Finalized Operation and Maintenance manuals.
21. Certificates of Compliance/Manufacture.
    a. Provide letter signed in the presence of a notary attesting that the manufacturer satisfies qualifications stated in this Section.

22. Reports.
    a. All shop test and field test reports.
    b. All manufacturer's Site visit reports.

1.08 DELIVERY, STORAGE, AND HANDLING

A. V&SC devices and systems shall be delivered, stored, protected, and handled in accordance with the manufacturer’s instructions, this Section, and the Contract Documents.

B. The Contractor shall inspect and report concealed damage to carrier within the specified time.

C. V&SC devices and systems shall be shipped and delivered in convenient shipping packages.
    1. Each package shall be mounted on shipping skids and wrapped for protection.
    2. Shipping package shall contain accessories to permit handling by cranes.

D. Contractor shall store the V&SC devices and systems and associated equipment in accordance with manufacturer’s recommendations.
    1. Store all equipment in clean, dry space.
    2. Maintain factory protective wrappings or cover with heavy canvas or plastic to keep out dirt, water, and construction debris.
    3. Within 24 hours of receiving the V&SCs, the Contractor shall install temporary heaters to prevent condensation during storage.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish all spare parts, special tools, and supplies in conformance with this Section and the Contract Documents.

B. Deliver all spare parts, tools, and supplies with the V&SCs and associated equipment, neatly wrapped or boxed, indexed and tagged with complete information for use and reordering.

C. Furnish all spare parts as recommended by the manufacturer.

D. Furnish the following tools:
    1. Two (2) sets of specialized wrenches and tools as required for proper installation, operation, and maintenance.

E. Lubricants
    1. The Contractor shall furnish as part of the bulk lubricant order the quantity of lubricants required to operate and maintain the equipment furnished under this section for a period of one (1) year after acceptance.

a. Replace all lubricants used during start-up and testing prior to acceptance of equipment.

b. Furnish this replacement lubricant in addition to the lubricants included in the bulk order.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Vibration and Seismic Control Devices shall be as manufactured by:

1. Korfund Dynamics/The VMC Group, Bloomingdale, NJ
2. Mason Industries, Hauppauge, NY.
3. California Dynamics Corporation, Los Angeles, CA.
4. Vibration Eliminator Co. Inc., Copiague, NY.
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Vibration Control Devices(VCDs)

1. Type 1 (Elastomeric/ Fiber Glass Pads)
   a. Elastomeric isolators shall be pads or molded configuration.
   b. Pads shall be used in single and multiple layers.
      1) Multiple layer pads shall comprise a bonded, galvanized sheet metal separation plate between each layer.
      2) A load distribution plate shall be required to evenly distribute the load over the surface of the pad.
2. Type 2 (Elastomeric Mounts)
   a. Elastomeric Isolator Mounts shall be molded from oil, ozone, and oxidant-resistant compounds, designed to operate within the strain limits of the material.
   b. Isolators shall include encapsulated load transfer plate for bolting to equipment and a base plate with anchor holes for bolting to the supporting structure.
3. Type 3 (Steel Spring Isolators)
   a. Steel Spring Isolators shall be a freestanding and laterally stable spring assembly without a housing.

b. Isolators shall comprise a leveling device rigidly connected to the equipment or frame above.

4. Type 4 (Restrained Spring Isolators)

a. Spring Isolator shall be equipped with a restrained steel housing to prevent the equipment's operating height from changing should it be necessary to temporarily remove a portion of its weight.

1) The housing shall also function as rigid blocking during rigging so that the installed height and the operating height of the isolated equipment remains the same.

2) The isolator top shall have adequate means for fastening to the equipment, and baseplate shall have adequate means for fastening to the supporting structure, when the equipment is subject to wind loading.

5. Type H1 (Elastomeric Hanger)

a. Elastomeric Hangers shall comprise an elastomeric isolation element contained in a steel hanger housing.

b. The elastomeric element/hanger shall be shaped to prevent the rod from contacting the housing and thereby short-circuiting the isolation.

c. A steel load-distribution plate shall be incorporated/furnished sandwiching the elastomeric element to the hanger housing.

6. Type H2 (Spring Hanger)

a. Spring Hangers shall comprise a stable steel spring contained in a steel hanger housing with an integral elastomeric element to prevent metal to metal contact.

b. The bottom hole must be large enough to allow a +/- 15 degree (30 degree total) rod misalignment.

7. Type H3 (Combination Elastomeric/Spring Hanger)

a. Combination Elastomeric/Spring Hanger shall comprise a stable steel spring contained in a steel hanger housing.

b. An elastomeric element shall be added in series to isolate the upper connection of the hanger box to the structure.

c. The bottom hole must be large enough to allow a +/- 15 degree (30 degree total) rod misalignment.

8. Support Bases with VCDs

a. Type B (Structural Bases)

1) Structural Bases with integral isolators shall be engineered steel frames manufactured from structural steel shapes with welded height-saving brackets as required for side mounting of the isolators.

2) Frames may be square, rectangular or T-shaped.

3) Adjustable motor slide bases shall be included when required for centrifugal fan applications.

b. Type C (Concrete Inertia Bases)

1) Concrete Inertial Bases shall be engineered steel forms with integrated isolator brackets.

2) Bases shall be shipped ready to be filled with concrete on Site by the Contractor.

3) Bases shall include welded or tied reinforcing bars running both ways in a single layer.

4) The bases shall include a template and fastening devices for the equipment for which it will be mated.

5) Weight of concrete and frame shall not be less than the weight of the equipment it supports.

6) Inertia bases shall be at least six inches in depth.

7) Inertia bases shall be sized to accommodate the elbow support(s).

8) Adjustable motor slide bases shall be included when required for centrifugal fan applications.

c. Type D-1 (Curb Isolation Rails)

1) Vibration isolation curb elements shall be inserted between rooftop equipment and existing roof curbs.

2) Elements shall be of aluminum or steel construction and shall be attached to the equipment as specified by the curb isolation manufacturer.

3) Incorporated vibration isolators shall meet the specific characteristics described in this Section.

4) Elements exposed to the weather shall be galvanized or manufactured out of corrosion-resistant materials.

5) Contractor shall be responsible for proper attachment of curb isolation elements to curbs.

6) Contractor shall be responsible for verifying the adequacy of the existing curb and its anchorage to the roof structure.

d. Type D-2 (Vibration Isolated Roof Curbs)

1) Curbs used to attach rooftop equipment to the structure shall be of aluminum or steel construction and shall be attached to the equipment as specified by the curb manufacturer.

2) Incorporated vibration isolators shall meet the specific characteristics described in this Section.

3) Elements exposed to the weather shall be galvanized or manufactured out of corrosion resistant materials.

4) Contractor shall be responsible for proper attachment of rooftop curb to building structure.

5) Contractor shall be responsible for coordinating the location of adequate structural support for the rooftop curb with the general contractor.

B. Seismic Control Devices (SCDs)

1. Type A (Coil Spring Isolator Incorporated Within a Cast Iron or Cast Aluminum Housing)

a. Cast iron or aluminum housings shall be made of ductile forms of the material designed for and rated in seismic restraint applications.

2. Type B, C, and D (Coil Spring Isolator Incorporated Within a Steel Housing)

a. Spring isolators shall be seismically restrained, incorporating single or multiple coil spring elements, having all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this Section.

b. Springs shall be restrained using a housing, without significantly degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.

c. Vibration isolators shall incorporate a steel housing and resilient snubbing grommet system designed with clearances of no more than 0.25” (6 mm) in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing.

1) In addition to the primary isolation coil spring, the isolator will include a resilient pad in series with the spring(s).

d. Spring elements shall be color-coded or otherwise easily identified.

e. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be selected to provide a 50% overload capacity.

f. All springs shall be provided with a finish suitable for the application.

3. Type E (All-Directional Elastomeric Isolator)

a. Vibration Isolators shall be elastomeric, molded from oil, ozone, and oxidant-resistant compounds, designed to operate within the strain limits of the isolator to provide the maximum isolation and longest life expectancy possible.

b. Isolators shall include an encapsulated load transfer plate for bolting to equipment and a base plate with anchor holes for bolting to the supporting structure.

c. Cast iron or aluminum housings shall be made of ductile forms of the material designed for and rated in seismic restraint applications.

d. Isolator shall have minimum operating static deflections, as detailed in this Section or as shown on the Contract Drawings, and shall not exceed published load capacities.

4. Type F (All-Directional External Seismic Snubber Assembly).

a. Equipment shall be restrained against excessive movement during a seismic event by the use of all-directional resilient snubbers, designed to withstand the Project-required seismic forces.

b. A minimum of three (3) snubbers shall be used for each equipment installation, oriented to properly restrain the isolated equipment in all directions.

c. Snubbers shall be of interlocking steel construction and shall be attached to the building structure and equipment in a manner consistent with anticipated design loads.

d. Snubbers shall limit equipment movement at each snubber location to a maximum of 0.25 inches (six mm) in any direction.

e. Snubbers shall include a minimum 0.25 inches (six mm)-thick resilient pad to cushion any impact and to avoid any potential for metal-to-metal contact.

f. Snubbers shall be installed without significantly degrading the vibration isolation capabilities of the isolator during normal equipment operating conditions.

5. Type G (Lateral External Seismic Snubber Assembly)

a. Stable equipment (where uplift forces are zero or are addressed by other restraints) shall be restrained against excessive lateral movement during a seismic event by the use of lateral resilient snubbers, designed to withstand the expected seismic forces.

b. A minimum of three (3) snubbers shall be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.

c. Snubbers shall be of steel construction and shall be attached to the building structure and equipment in a manner consistent with anticipated design loads.

d. Snubbers shall limit equipment movement at each snubber location to a maximum of 0.25 inches (six mm) in any direction.

e. Snubbers shall include a minimum 0.25 inches (six mm)-thick resilient pad to cushion any impact and to avoid any potential for metal-to-metal contact.

f. Snubbers shall be installed without significantly degrading the vibration isolation capabilities of the isolator during normal equipment operating conditions.

6. Type H (Omni-Directional External Seismic Snubber Assembly)

a. Equipment shall be restrained by the use of omni-directional resilient snubbers, designed to withstand the expected seismic forces.

b. A minimum of four (4) snubbers shall be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.

c. Snubbers shall be of steel construction and shall be attached to the building structure and equipment in a manner consistent with anticipated design loads. Snubber clearances shall be limited to a maximum of 0.25” (six mm) in any direction.

d. Snubbers shall include resilient pads with a minimum thickness of 0.25” (six mm) to cushion any impact and to avoid any potential for metal-to-metal contact.

e. Snubber shall be installed without significantly degrading the vibration isolation capabilities of the isolator during normal equipment operating conditions.

7. Type I: Horizontal Single-Axis External Seismic Snubber Assembly

a. Stable equipment (where uplift forces are zero or are addressed by other restraints) shall be restrained against excessive lateral movement during a seismic event by the use of horizontal single-axis resilient snubbers designed to withstand the expected seismic forces.

b. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.

c. Snubbers shall be of steel construction and shall be attached to the building structure and equipment in a manner consistent with anticipated design loads.

d. Snubber clearances shall be limited to a maximum of 0.25” (six mm) in any direction.

e. Snubbers shall include resilient pads with a minimum thickness of 0.25” (six mm) to cushion any impact and to avoid any potential for metal-to-metal contact.

f. Snubbers shall be installed without significantly degrading the vibration isolation capabilities of the isolator during normal equipment operating conditions.

8. Type J (Cable Restraints for Suspended Components and Systems)

a. Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist expected seismic loads and to restrain suspended components and systems in all lateral directions.

b. Protective thimbles shall be used to eliminate potential for dynamic cable wear and strand breakage, if required.

c. Restraint system shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is less.

d. Anchor load is to be calculated taking into account the geometry of the bracket.

e. Seismic wire rope connections shall be made using overlapping wire rope “U” clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.

f. Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical compression forces.

g. Braces shall be selected to be of sufficient strength to prevent support rod buckling.

1) Braces shall be attached to the vertical suspension rod by a series of attachment clips.

h. Where clevis hanger brackets are used for seismic restraint attachment, the cross bolt shall be fitted with internal bracing to prevent deformation of the clevis hanger.

9. Type K (Rigid Restraints for Suspended Components and Systems.)

a. Rigid restraints shall consist of structural elements, sized to resist expected seismic loads and to restrain suspended components and systems in all lateral directions.

b. Structural elements shall be capable of carrying both compressive and tensile loading.

c. Restraint system shall be sized to the capacity of the cable, or to the capacity of the anchorage, whichever is less.

d. Anchor load shall be calculated taking into account the geometry of the bracket.

e. Anchorage of static support system shall be capable of carrying the additional tension loads generated by the compression of the rigid brace.

1) This is the vertical component of the compressive force in the brace.

2) This load is additive to any static load requirements on the system.

f. Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical compression forces.

g. Braces shall be selected to be of sufficient strength to prevent support rod buckling.

1) Brace shall be attached to the vertical suspension rod by a series of attachment clips.

h. Where clevis hanger brackets are used for seismic restraint attachment, the cross bolt shall be fitted with internal bracing to prevent deformation of the clevis hanger.

10. Type L (Roof Curbs (Non-Isolated))

a. Curbs or fabricated equipment piers used to attach rooftop equipment to the structure shall be of steel construction and shall be attached to the equipment as specified by the manufacturer.

b. Contractor shall be responsible for proper seismic attachment of rooftop curb to building structure.

c. Contractor shall be responsible for coordinating the location of adequate structural support for the rooftop curb.

Components exposed to the weather shall be galvanized or manufactured out of corrosion resistant materials.

11. Type M (Roof Curbs (Isolated))

a. Curbs or fabricated equipment piers used to attach rooftop equipment to the structure shall be of steel construction and shall be attached to the equipment as specified by the manufacturer.

b. Contractor shall be responsible for proper seismic attachment of rooftop curb to building structure.

c. Contractor shall be responsible for coordinating the location of adequate structural support for the rooftop curb.

d. Curbs or piers shall be fitted with snubbers capable of resisting all anticipated design load conditions.

e. Snubber clearances in all planes shall be limited to a maximum of 0.25” (six mm) in any direction.

f. Snubbers shall include a minimum 0.25” (six mm)-thick resilient pad to cushion any impact and to avoid any potential for metal-to-metal contact.

g. Snubber shall be installed without significantly degrading the vibration isolation capabilities of the isolator during normal equipment operating conditions.

h. Components exposed to the weather shall be galvanized or manufactured out of corrosion resistant materials.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. Painting shall be in accordance with Section 09 91 90 – Painting.

2. All internal and external metal surfaces of the V&SC devices shall be thoroughly cleaned, rinsed, and phosphatized prior to painting.

3. All steel components shall be cleaned of welding slag and coated with an approved primer.

4. All steel components (excluding springs) on projects exposed to the weather shall be hot-dip galvanized or powder coated.

5. Springs shall be cadmium or zinc plated, powder-coated, epoxy or PVC finished.

6. The V&SC devices shall be painted with a thermosetting electrostatically applied polyester powder with final baked on average thickness between 1.5 to 2.0 mils.

7. The color of all interior finishing coats shall be the manufacturer’s standard.

8. The color of the exterior finishing coats shall be the manufacturer’s standard.

9. The finish shall have a minimum pencil hardness of 2H as tested per ASTM D3363 and shall pass ASTM B117 5% salt spray test for a minimum of 1000 hours.

10. A supply of touch-up paint shall be provided from paint used for the final coat.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine areas and equipment to receive V&SC devices and building expansion/seismic joint for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine rough-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by of the Engineer.

3.02 INSTALLATION

A. Vibration Control Devices

1. VCDs shall be installed in accordance with the manufacturer's instructions and recommendations.

2. VCDs shall not be installed in a manner that will result in equipment stress or misalignment.

3. Isolated equipment or components shall not be installed in manner that makes rigid connections with the building structure unless isolation is not specified

a. Building structure includes, but is not limited to slabs, beams, columns, studs, and walls.

b. Coordinate Work with other trades to avoid rigid contact with the building structure.

4. Upon completion of installation of all equipment and VCDs and before adjusting the VCDs, all debris shall be cleaned from beneath the isolated equipment, to avoid the possibility of short-circuiting the isolation system.

5. The Contractor shall notify the local representative of the vibration isolation manufacturer prior to installing any vibration isolation devices. The Contractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.

B. Seismic Control Devices

1. SCDs shall be installed as per the manufacturer's written instructions.
2. SCDs shall not be installed in a manner that will result in equipment stress or misalignment.
3. Isolated equipment or components shall not be installed in manner that makes rigid connections with the building structure unless isolation is not specified.
    a. Building structure includes, but is not limited to slabs, beams, columns, studs, and walls.
    b. Coordinate Work with other trades to avoid rigid contact with the building structure.
4. Upon completion of installation of all SCDs and before start-up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.
5. All external utility connections to restrained equipment shall be designed to allow differential seismic motion without damage to the equipment or utility connections.
6. Adjust isolators and restraints after systems have been filled and equipment is at its operating weight, following manufacturer's written instructions.
7. After equipment installation is completed, adjust limit stops following manufacturer's written instructions so they are out of contact during normal operation.
8. Adjust snubbers according to manufacturer's written instructions.
9. Torque anchor bolts according to anchor manufacturer's written instructions to resist seismic forces.
10. V&SCS equipment shall be installed in accordance with manufacturer's instructions and recommendations.
11. V&SCS equipment shall be installed so that sufficient access and working space is provided for ready and safe operation and maintenance.
12. V&SCS equipment shall be installed on concrete pads at locations shown on the Contract Drawings.
13. Steel channels shall be provided for support of V&SCS equipment.
14. V&SCS equipment shall be securely mounted to mounting surface with anchor bolts.
15. Anchor V&SCS to satisfy the specified seismic requirements in accordance with the anchorage details.
16. Install nameplates for identification of V&SCS equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, V&SCS shall be field tested for operation and conformance.
2. The Contractor shall perform field tests in accordance with this Section and Contract Documents.
3. The field tests shall be witnessed by the Engineer and certified by the Contractor.
4. V&SCS testing shall be performed by the manufacturer's representative, prior to energizing equipment.
5. Equipment shall not be energized without the permission of the Engineer.
6. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall consist at a minimum of the following:
    a. Upon completion of the installation of all vibration isolation devices herein specified, the local representative of the vibration isolation manufacturer shall, at the Contractor’s request, inspect the completed system and report in writing any installation errors or other fault in the system which could affect the performance of the system.

B. The installing contractor shall submit a report upon request to the building architect and/or the Engineer, including the manufacturer’s representative’s final report, indicating that all vibration isolation material has been properly installed, or steps that are to be taken by the contractor to properly complete the vibration isolation Work as per the Contract Documents.

C. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the V&SCS, check the V&SCS installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations, and train the Contractor and the City’s operations and maintenance staff in the care, operation, and maintenance of the V&SCS.
2. The Contractor shall provide V&SCS equipment start-up services and training in accordance with this Section and the Contract Documents and the following requirements:
3. Minimum number of manufacturer’s representative site visits per V&SCS:

Construction Phase	No of Visits	Person-Days	No of Day per Visit
Installation	Update during Design	Update during Design	Update during Design
Field Tests	Update during Design	Update during Design	Update during Design
Acceptance Testing	Update during Design	Update during Design	Update during Design
Training	Update during Design	Update during Design	Update during Design

4. Any additional time required to achieve a successful installation shall be at the expense of the Contractor.
5. The Engineer shall have the right to reallocate any unused person-days.
6. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.
    a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.
7. The service representative shall sign in and out with the Engineer on each day they are at the Site.
    a. Person-days shall be understood to be the actual time spent at the Site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. The Contractor shall provide V&SCS start-up services and Training in accordance with this Section and the Contract Documents.
    1. Acceptance Testing
    2. The Contractor shall provide acceptance testing of the V&SCS.
    3. All acceptance testing shall be performed by the testing firm, after the completion of the field tests specified under this Section.
    4. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.
    5. Acceptance testing inspection shall be performed on each V&SCS. Inspection shall include the following:
        a. Physical, electrical and mechanical condition shall be inspected.
        b. Proper anchorage, required area clearances, physical damage, and proper alignment shall be checked.
        c. Ventilating air passageways shall be inspected for blockage.

d. All connections shall be inspected for high resistance.

e. Electrical and mechanical interlock systems shall be checked for proper operation.

f. Insulators shall be inspected for evidence of damage or contamination.

g. Equipment shall be cleaned and lubricated as required.

6. Acceptance electrical testing shall be performed on each V&SCS. Testing shall include the following:

a. Ground-resistance tests shall be performed.

b. Insulation-resistance tests shall be performed on each bus section, on each switch, transformer and circuit breaker, phase-to-phase, and phase-to-ground.

c. An over potential test shall be performed on each bus section, each phase-to-ground, and on each switch in the closed position. Test each pole with other poles grounded.

d. Contact-resistance test shall be performed.

e. Control and metering wiring performance test shall be performed.

f. Circuit breaker trip characteristics shall be determined by primary current injection.

g. All tests and values shall be in accordance with the manufacturer's recommendations and NETA ATS.

h. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Upon completion of the installation of all vibration isolation devices herein specified, the local representative of the vibration isolation manufacturer shall, at the Contractor’s request, inspect the completed system and report in writing any installation errors or other fault in the system which could affect the performance of the system.

B. The installing contractor shall submit a report upon request to the building architect and/or the Engineer, including the manufacturer’s representative’s final report, indicating that all vibration isolation material has been properly installed, or steps that are to be taken by the Contractor to properly complete the vibration isolation Work as per the Contract Documents.

END OF SECTION

Appendix

Schedule of Vibration Control Devices

Vibration Isolation Type	Product Description	Product Manufacturer	VISCMA Member Model(s)
1	Elastomeric / Fiberglass Pads	CalDyn/California Dynamics	RP ECPR VT FP EP
		Mason Industries, Inc.	W/SUPER W
		Vibration Eliminator Co., Inc.	100N/200N/400N (NP)
		The VMC Group	MAXIFLEX/NRC/ SHEARFLEX/NR FABRIFLEX/NDB
2	Elastomeric Mounts	CalDyn/California Dynamics	RM-D JQTQN
		Mason Industries, Inc.	BRA/BRB/BRC/BRD RAA, RBA, RCA, RDA
		Vibration Eliminator Co., Inc.	T44/D44/T54/3865 (TD)
		The VMC Group	RSM/RDC/MB R/RD/RVD
3	Steel Spring Isolators	CalDyn/California Dynamics	SSL SSK
		Mason Industries, Inc.	SLF
		Vibration Eliminator Co., Inc.	OST
		The VMC Group	A-SERIES/SW/AW
		Mason Industries, Inc.	SLR/SLRS
		Vibration Eliminator Co., Inc.	KW
		Vibro-Acoustics	CSR/SCSR/SFS
		The VMC Group	MS/MSS/AWRS/M SWSR/AMSR/AEQM/ ASCM
H1	Elastomeric Hangers	CalDyn/California Dynamics	RH RH-D
		Mason Industries, Inc.	HD/CRCH
		Vibration Eliminator Co., Inc.	1C/3C/3CTD
		The VMC Group	HR/RH/BRD/HRD
H2	Spring Hangers	CalDyn/California Dynamics	CH/30
		Mason Industries, Inc.	30/CSCH
		Vibration Eliminator Co., Inc.	SNC
		The VMC Group	HSA SH/BSA
H3	Combined Elastomeric/Spring Hangers	CalDyn/California Dynamics	HH/30
		Mason Industries, Inc.	30N
		Vibration Eliminator Co., Inc.	SNRC
		The VMC Group	HRSA RSH-30A/BSRA

Schedule of Vibration Control Devices (continued)

Equipment Support Base Type	Product Description	Product Manufacturer	VISCMA Member Model(s)
B	Structural Bases	CalDyn/California Dynamics	WW SW XW
		Mason Industries, Inc.	MSL/WFSL
		Vibration Eliminator Co., Inc.	UN-OST/UN-KW
		The VMC Group	SFB/WFB/WX/WSB
C	Concrete Inertia Bases	CalDyn/California Dynamics	CW
		Mason Industries, Inc.	BMK/KSL
		Vibration Eliminator Co., Inc.	OST/KW Frames
		The VMC Group	MPF/CPF/WPF
D-1	Curb Isolation Rails	CalDyn/California Dynamics	JQ
		Mason Industries, Inc.	CMAB
		Vibration Eliminator Co., Inc.	'AR' Bases
		The VMC Group	RTIR
D-2	Roof Curbs (Isolated)	CalDyn/California Dynamics	MW YW
		Mason Industries, Inc.	RSC/ISC
		Vibration Eliminator Co., Inc.	VERC
		The VMC Group	P-6100/P-6200/P-6300 P-7100/P-7200/P-7300

Schedule of Seismic Control Devices

Seismic Snubber Type	Seismic Product Description	Product Manufacturer	**VISCMA Member Model(s)**
A	Coil Spring Isolator Incorporated Within A Ductile Iron Or Cast Aluminum Housing	CalDyn/California Dynamics	RJ, TJ
		Mason Industries, Inc.	SSLFH
		Vibration Eliminator Co., Inc.	OSTSM
		The VMC Group	AEQM
B	Coil Spring Isolator Incorporated Within a Steel Housing	CalDyn/California Dynamics	JQ, DL
		Mason Industries, Inc.	SLR
		Vibration Eliminator Co., Inc.	KWSR
		The VMC Group	ASCM
C	Coil Spring Isolator Incorporated Within A Steel Housing	CalDyn/California Dynamics	JQ, DL
		Mason Industries, Inc.	SLRS
		Vibration Eliminator Co., Inc.	KWSR
		The VMC Group	CTER, AWRS, AWMR
D	Coil Spring Isolator Incorporated With Integral Seismic Restraint	CalDyn/California Dynamics	JQ, DL
		Mason Industries, Inc.	SLRS
		Vibration Eliminator Co., Inc.	OSTSM
		The VMC Group	SWSR
E	All Direction Elastomeric Isolator	CalDyn/California Dynamics	TYPE JQ-TQN
		Mason Industries, Inc.	RBA, RCA, BRA, BRB,
		Vibration Eliminator Co., Inc.	368SRS, 368SRD, SM
		The VMC Group	RSM, MB, SRVD, RDC
F	All Direction 3-Axis External Seismic Snubber Assembly	CalDyn/California Dynamics	RL-A, RL-C
		Mason Industries, Inc.	Z-1225
		Vibration Eliminator Co., Inc.	ADR
		The VMC Group	ERX, SR
G	Lateral 2-Axis External Seismic Snubber Assembly	CalDyn/California Dynamics	RL-A, RL-C
		Mason Industries, Inc.	
		Vibration Eliminator Co., Inc.	ADR
		The VMC Group.	
H	Omni-Directional 3-Axis External Seismic Snubber Assembly	CalDyn/California Dynamics	RL-A, RL-C
		Mason Industries, Inc.	Z-1011
		Vibration Eliminator Co., Inc.	
		Vibro-Acoustics	
		The VMC Group	ER

Schedule of Seismic Control Devices (continued)

Seismic Snubber Type	Seismic Product Description	Product Manufacturer	VISCMA Member Model(s)
I	Horizontal 1-Axis External Seismic Snubber Assembly	CalDyn/California Dynamics	RL-A, RL-C
		Mason Industries, Inc.	
		Vibration Eliminator Co., Inc.	HCS
		The VMC Group	SR
J	Cable Restraints For Suspended Components and Systems	CalDyn/California Dynamics	
		Mason Industries, Inc.	SCB
		Vibration Eliminator Co., Inc.	SC
		The VMC Group	SCR, SB, LRC
K	Rigid Restraints For Suspended Components and Systems	CalDyn/California Dynamics	
		Mason Industries, Inc.	SSB
		Vibration Eliminator Co., Inc.	
		The VMC Group	SAB
L	Roof Curbs (Non-Isolated)	CalDyn/California Dynamics	N/A
		Mason Industries, Inc.	RRC
		Vibration Eliminator Co., Inc.	VERSC, SQRC
		The VMC Group	P6000
M	Roof Curbs (Isolated)	CalDyn/California Dynamics	MW, YW
		Mason Industries, Inc.	RSC
		Vibration Eliminator Co., Inc.	VERC
		The VMC Group	R6200, R6300, RTIC

NO TEXT ON THIS PAGE

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing labeling and identification.

1. Labeling and identification shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

2. Labeling and identification shall be provided for the identification of electrical equipment.

B. The Work shall include providing all voltage signs, equipment nameplates, markers, tags, and arc flash labels for all electrical equipment furnished under this Contract.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	2
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 14 - Medium-Voltage Cables and Accessories

B. Section 26 05 20 - Low-Voltage Wires, Cables and Accessories

C. Section 26 05 33 - Raceways and Boxes for Electrical Systems

D. Section 40 05 97 - Identification for Process Equipment

1.04 REFERENCES

A.	NYCEC	-	New York City Electrical Code
B.	NFPA 70E	-	Standard for Electrical Safety in the Workplace
C.	ANSI Z535.4	-	American National Standard for Product Safety Signs and Labels
D.	BWT Arc Flash	-	Arc Flash Personal Protective Equipment BWT Guidelines
E.	OSHA 1910 Subpart S	-	Electrical

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. All labeling and identification signs and nameplates shall be provided in accordance with the NYCEC, NFPA 70E and OSHA 1910 Subpart S.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include but not be limited to:

1. Submit signs, nameplates, and other labeling and identification devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The labeling and identification devices shall be delivered, stored, and handled in accordance with the Contract Documents and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Labels shall be as manufactured by:

1. Brady, Milwaukee, WI;
2. Seton Nameplate Corporation, North Branford, CT;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. High Voltage Signs

1. High voltage signs shall be provided for equipment operating over 600 volts.
2. High voltage signs shall be fiberglass reinforced polyester, rigid acrylic or aluminum plate 1/16-inch thick. Finish shall be industry standard of red, white and black graphics. Signs shall be 10 inches by 14 inches with the following exceptions:
    a. Use 7-inch by 10-inch signs where this is the largest size that can be applied.
    b. Use 14-inch by 20-inch signs where needed for adequate vision.
3. High voltage signs shall read; "DANGER - HIGH VOLTAGE KEEP OUT".
4. High voltage sign mounting screws shall be 3/16 inch diameter, round head, stainless steel, and self-tapping type.

B. Equipment Nameplates

1. Equipment nameplates shall be provided in addition to the manufacturer’s nameplate, to identify the equipment number and the item’s function and the equipment to which it serves.
2. Equipment nameplates shall be provided in accordance with the requirements specified under this Section and Section 40 05 97 – Identification for Process Equipment.
3. Equipment nameplates shall be laminated plastic with black letters on a white background.
4. Nameplates for equipment identification shall have 1/2-inch high letter engravings.
5. Nameplates for pilot device identification shall have 1/4-inch high letter engravings.
6. Nameplates for distribution equipment shall have the following information:
    a. Equipment name and number.

b. Voltage.

c. Phases and number of wires.

7. Pull boxes, junction boxes, and control stations shall have a nameplate identifying the equipment name and number.

8. All feeders and branch circuit devices shall have nameplates identifying the served equipment name and number.

9. Where execution of the Work under this Contract requires certain feeders and branch circuit devices to be modified, the Contractor shall provide new nameplates reflecting the modifications. The nameplates shall identify the served equipment name and number.

10. All control and indicating devices shall have individual nameplates identifying device function.

11. Nameplate mounting screws shall be 3/16 inch diameter, round-head, stainless steel and self-tapping type. Adhesives shall not be used.

C. Conduit Markers and Tags

1. Conduit markers and tags shall be provided for the identification of the electric conduit system.

2. Conduit markers and tags shall be in accordance with Section 26 05 33 - Raceways and Boxes for Electrical Systems.

D. Cable and Wire Markers

1. Cable and wire markers shall be provided for the identification of the electric wire and cable.

2. Cable and wire markers shall be in accordance with Section 26 05 14 - Medium-Voltage Cables and Accessories and Section 26 05 20 - Low-Voltage Wires, Cables and Accessories.

E. Arc Flash Labels

1. Labels shall be provided in addition to the manufacturer’s nameplate and equipment nameplate to identify equipment name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes, and AFIE (Arc Flash Incident Energy) levels.

2. Labels shall be able to withstand their usage environment, the print shall not fade, and adhesive should be aggressive enough to avoid peeling.

3. Arc flash labels shall be printed on a durable polyester base over-laminated to protect the text and graphics.

4. The back of the labels shall employ an acrylic adhesive, which allows the labels to be securely and permanently affixed to a wide range of surfaces.

5. Labels shall include no field markings.

6. Labels shall be generally in accordance with ANSI Z535.4.
7. Labels shall include at a minimum the following information based on the Arc Flash Hazard Analysis performed:
    a. Nominal Voltage of the Equipment
    b. Flash Protection Boundary
    c. Personal Protective Equipment category at the working distance Personal Protective Equipment category at the working distance, or Arc Flash Incident Energy Value (cal/cm^2) at the working distance
    d. Limited and Restricted Boundaries
    e. Study Report Number and Issue Date
    f. Location of Study Report.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Signs and Nameplates
    1. All signs, nameplates, and tags shall be installed neatly, properly, and as recommended by the manufacturers.
    2. Signs and nameplates shall be mounted with screws.
        a. Where mounting of signs or nameplates with screws is impractical, the Contractor shall alert the Engineer.

B. High Voltage Signs
    1. High voltage signs shall be installed on equipment operating at over 600 volts. High voltage signs shall also be installed on sides of fences or walls which enclose outdoor equipment operating at over 600 volts.

C. Signal Wire and Cable
    1. Control, signal, and status wires and cables shall be identified by a unique number. The numbering system shall reflect the actual identification used in the Work and shall be documented on the point-to-point wiring diagrams.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 05 73 – POWER SYSTEM STUDIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing Power System Studies and field testing. The Contractor shall provide Power System Studies and field testing in accordance with the requirements specified under this Section and the Contract Documents.

B. The Power System Studies shall include a load flow study, a short circuit study, a protective device evaluation study, and a protective device coordination study for a completely coordinated power distribution system. Power System studies shall include other studies as applicable, including but not limited to motor starting and harmonic studies.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Power System as used in this Section shall mean all of the electrical distribution network from the Utility connection to all loads. This includes all on Site generating sources, all branches, and all nodes.

2. Low-Voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation at less than 1000 volts and within the 600 V Class.

3. Medium-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation above 1000 volts and below 99000 volts.

4. Node as used in this Section shall mean any point in the Power System where two or more pieces of electrical equipment connect.

5. Branch as used in this Section shall mean any element of the Power System connecting any two nodes.

6. Major Node as used in this Section shall mean any node representing actual real world connection points of branches of the Power System such as busses in switchgears, MCCs or panelboards, or the connection points of cables to load and equipment.

7. Dummy Node as used in this Section shall mean any fictitious node created within the modelling software to facilitate modelling of the Power System.

8. Major Branch as used in this Section shall mean any branch representing actual real-world elements of the Power System such as feeders, breakers, transformers, and cables.

9. Dummy Branch as used in this Section shall mean any fictitious branches created within the modelling software to facilitate modelling of the Power System.

10. All references to the Electric Utility or Utility shall mean the Local Electric Utility having jurisdiction as defined in this Section.

11. The Electric Utility is Con Edison.

12. Harmonic Sources as used in this Section shall mean

    a. All equipment drawing non-linear currents and causing the voltage and currents at the node to which they are connected and other nodes to exhibit non-linear voltage and current characteristics. Equipment includes:

        1) Convertors in variable frequency drives and switch mode power supplies.

        2) Semiconductor switches modulating the voltage in soft starters, light dimmers and electronic ballast.

b. Utility sources whose waveforms are distorted dues to non-linear loads at other consumers on the Utility network.

13. Point of Common Coupling (PCC) is the node where the Power System is connected to the Utility.

a. Subordinate PCCs may be also defined at the nodes within the Power System where the equivalent network of the Utility and the Power System and specific harmonic sources are connected.

b. PCCs are shown on the Contract Drawings.

B. Reference Standards

1.	NYCEC	-	New York City Electrical Code
2.	IEEE 141	-	IEEE Recommended Practice for Electric Power Distribution in Industrial Plants
3.	IEEE 399	-	IEEE Recommended Practice for Industrial and Commercial Power System Analysis
4.	IEEE 519	-	IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
5.	IEEE 1015	-	IEEE Recommended Practice for Applying Low-Voltage Breakers Used in Industrial and Commercial Power Systems
6.	IEEE 3002.2	-	IEEE Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems
7.	IEEE 3002.3	-	IEEE Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems
8.	IEEE 3002.7	-	IEEE Recommended Practice for Conducting Motor-Starting Studies and Analysis of Industrial and Commercial Power Systems
9.	IEEE 3002.8	-	IEEE Recommended Practice for Conducting Harmonic Studies and Analysis of Industrial and Commercial Power Systems
10.	NETA ATS	-	NETA Acceptance Testing Specification

1.05 DESCRIPTION

A. Power Systems Studies shall be completed by modelling the entire low-voltage and medium-voltage equipment of the Power System in the software detailed in this Section. The studies shall encompass existing systems and the proposed systems.

B. The model shall comprise all major nodes and major branches of the Power System.

C. The model shall also comprise dummy nodes and dummy branches to attain a level of connectivity similar to the Single Line Diagram representation of the Power System.

D. The model shall completely facilitate the examination of normal operations, and alternate operations of the Power System which could result in deviations from the normal operating values at major nodes and in major branches of the Power System.

1.06 QUALITY ASSURANCE

A. Modelling:

1. The Power System studies shall be performed in accordance with the latest applicable provisions and recommendations of the Reference Standards in this Section.

2. The Contractor shall retain the services of a licensed Professional Engineer, registered in the State of New York, to perform the Power System Studies.

3. The licensed Professional Engineer shall be from an independent consulting firm or the equipment manufacturer and shall have a minimum of five years of experience in performing Industrial Power System Studies.

4. It shall be the responsibility of the licensed Professional Engineer to:

a. Evaluate all devices.

b. Evaluate all equipment.

c. Determine all performance indices at the PCC.

d. Establish the settings of all protection functions.

e. Establish the settings required to secure selective coordination among protective devices.

5. Power System Studies shall be completed using the software program listed in this Section.

6. The Contractor shall coordinate with the licensed Professional Engineer performing the studies and assist the Professional Engineer in the collection of all information necessary to complete the studies specified.

7. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the NIST and NETA ATS.

8. The Contractor is responsible to coordinate with and obtain from utility company of the available minimum and maximum three phase and line to ground fault current with associated X/R ratios and voltage.

B. Field Testing:

1. The Power System shall be field tested. The field testing shall be performed in accordance with the requirements specified under this Section.

2. The Contractor shall retain the service of an independent testing firm who shall perform field testing of the Power System. The testing firm shall have

experience in the inspection and testing of the system equipment and shall be a member company of NETA. Provide proof of membership, or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer

1.07 SUBMITTALS

A. Submittals

1. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

   a. Experience of the licensed Professional Engineer who will perform the Power Systems Studies.

   b. Version of the software to be used to conduct Power Systems Studies.

   c. Calculations and results of the Power System Studies shall be submitted. The submission of calculation and results shall consist of:

      1) A report detailing all the findings, recommendations, and settings arising from the studies. The report shall be stamped and signed by the licensed Professional Engineer.

      2) The complete software files produced by the study software, and corresponding to the findings, recommendations, and settings contained in the report. Two copies of the software files shall be submitted, one copy shall be write-protected and the other shall not.

2. The Power System Studies shall be submitted for approval prior to receiving the final approval of the Power System equipment and/or prior to the release of equipment drawings for manufacturing.

3. Power System Studies shall be submitted for approval prior to the Engineer giving approval for drawings to be submitted for review by the Utility.

4. In the event that formal completion of the Power System Studies may cause delay in the approval of equipment or Utility drawings, then a preliminary submission of the Power System Studies shall be made. The Engineer will determine whether the preliminary submission is sufficient to allow approval of equipment and Utility drawings.

5. Work sequence for the field testing shall be submitted. The sequence shall indicate the schedule of Work, time frame, and downtime for the equipment. The Work sequence shall be submitted at least 60 days in advance prior to conformation of field testing dates.

6. Qualifications of proposed testing firm to perform field testing shall be submitted. Submit firm experience records at least 60 days in advance to actual testing along with five recent references with phone numbers.

B. Reports

1. Field test report shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Power Systems Analysis Software shall be as manufactured by

1. Power Analytics Corporation, Raleigh NC;

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Load Flow Study:

1. The load flow study shall be preliminary to all the other studies and for all proposed operating conditions of the Power System. The load flow study shall be used to:

a. Preset the study parameters as applicable for each of the studies listed under this Section.

b. Confirm the layout and balance of the power flows across the major branches

c. Establish the voltage profiles at all major nodes.

d. Identify real and reactive power flows into nodes and across the branches of the Power System.

e. Determine real and reactive power losses in the Power System.

f. Identify proposed transformer tap settings.

g. Problem areas or equipment capacity inadequacies shall be promptly brought to the Engineer's attention.

B. Short Circuit Study:

1. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each major node and through major branches and other significant locations through the system.
2. The short circuit tabulations shall include symmetrical fault currents and X/R ratios.
3. For each fault location, the total duty on the major nodes, as well as the individual contribution from each connected branch, including motor back EMF current contributions, shall be listed with its respective X/R ratio.

C. Protective Device Evaluation Study:

1. The protective device evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the prospective fault currents.
2. Appropriate multiplying factors based upon system X/R ratios and protective device rating standards shall be applied.

D. Protective Device Coordination Study:

1. The protective device coordination study shall be performed to select or to check the selections of the power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings.
2. The device settings computed in the coordination study shall provide complete selectivity.
    a. The system shall be selectively coordinated such that only the device nearest a fault will operate to remove a faulted circuit.
    b. System selectively shall be based on both the magnitude and the duration of a fault current.
3. The coordination study shall include all voltage classes of equipment starting at the utility's incoming feeder protective device down to and including each of the medium and low voltage load. The phase and ground overcurrent and ground fault protection shall be included, as well as settings for all other adjustable protective devices.
4. The time-current characteristics of the installed protective devices shall be plotted on the appropriate log-log paper. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate selective coordination achieved to the utility main breaker, power distribution feeder breakers, and the overcurrent devices at each major load center.

5. There shall be a maximum of six protective devices per plot. Each plot shall be appropriately titled. Plots shall include the following information as required for the circuits shown:
    a. Representative one-line diagram, legend, and types of protective devices selected.
    b. Utility's relays or fuse characteristics.
    c. Significant motor starting characteristics.
    d. Parameters of transformers, ANSI magnetizing inrush, and withstand curves.
    e. Operating bands of low voltage circuit breaker trip curves, and fuse curves.
    f. Relay taps, time dial, and instantaneous trip settings.
    g. Cable damage curves.
    h. Symmetrical and asymmetrical fault currents.
6. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.

E. Harmonics Study:
1. Provide a harmonics study for the Power System including Utility and alternate sources.
2. The goal of the Harmonic Study shall be:
    a. To identify and quantify all distortions in voltage and current waveforms in the Power System.
    b. To identify and quantify all resonances in the Power System.
    c. To evaluate the performance of the Power System at the PCC under all conditions of normal and alternate operations, ensuring compliance with the Recommended Harmonic Limits of IEEE 519 and or IEEE 3002.8.
    d. To ensure that all remedial measures required to achieve the Recommended Harmonic Limits and mitigate resonances are incorporated into the Power System.
3. Capacitor-Inductor filter traps that require tuning to the power system are not acceptable.
4. The Contractor, along with manufacturer of harmonic sources, shall provide for the design, furnishing, and installation of the remedial measures and appurtenances required to meet the requirements of the Harmonic Study.

5. The Contractor, along with the manufacturer of harmonic sources, is responsible to provide an updated single line diagram with referenced data within the submittal for this study.

6. The report shall be provided for approval prior to or with the Shop Drawings of the harmonic sources. Submittals of harmonic sources prior to or without the study will be considered incomplete and not reviewed.

F. Motor Starting Studies

1. Provide Motor Starting Study/Studies to determine the impact of the selected motor starting method/s proposed for this Contract.

2. Motor Stating Study/Studies shall be completed in accordance with IEEE 399 and or IEEE 3002.7

3. The Motor Starting Study/Studies shall include:

a. Starting Analysis for all motors 150 Hp and above or all motors whose starting impact is significant in relation to the Power System of this Contract.

b. Starting Analysis shall also be completed for less than 150 Hp motor/s where the following are impacting performance:

1) Variations in nominal or service voltage.

2) Size and length of feeder cable.

3) Simultaneous starting of groups of less than 150 Hp motors.

c. Determination of the impact of starting at motor bus and remote busses including but not limited to:

1) Motor/s will start with acceptable voltage drop.

2) Motor/s will accelerate within acceptable start-up times.

3) Motor/s are not subjected to nuisance tripping.

4) Voltage deviations will not disrupt loads at the motor bus and remote busses inclusive of stall of running motors.

5) Accurate evaluation of motor/load torque-speed characteristics.

6) Accurate assessment of motor/s life as a function of the starting method selected and thermal damage characteristics.

7) Voltage deviations causing variable performance of solid state and electronic equipment.

8) Voltage deviations causing lighting system/s flicker

9) Confirmation of the type of controller required to start the motor/s.

10) Confirmation of motor/s feeder sizes.

d. Recommendations to alleviate starting deficiencies identified by the Study/Studies.

1) All motors and controllers identified in the Motor Starting Study/Studies requiring specific measures to mitigate disturbances at connected and remote busses shall not be submitted without the mitigation measures clearly identified in the respective submittals.

e. Evaluation of all motor starting when the Power System is connected to the Utility or alternative on site Power Sources.

4. The report shall be provided for approval prior to or with the Shop Drawings of the harmonic sources. Submittals of harmonic sources prior to or without the study will be considered incomplete and not reviewed.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Study Input

1. The Contractor shall be responsible to ensure that all data to complete the Power System Studies is provided and is input to the software model, including but not limited to:

a. Selection of suitable base MVA, base voltage and base current.

b. Utility and on site generation, single and three phase fault current contributions including X/R ratios.

c. Motor contributions and sequence impedances including X/R ratios.

d. Sequence resistance and reactance of all major branches.

e. Transformer impedance, X/R ratios, winding connection, tap ranges and base ratings.

f. Models, test results or characterization of Harmonic Sources.

g. All other circuit parameter to permit the complete and accurate modelling of the Power System.

3.02 INSTALLATION

A. Study Report

B. The results of the Power System Studies shall be summarized in a final typewritten report. The report shall include the following Sections:

1. Executive Summary, Description, purpose, basis, written scope

2. Load Flow

a. Tabulations of load flow study results inclusive of normal, minimum, and maximum branch loadings along with normal, minimum, and maximum voltages at nodes.

b. Tabulations of power losses for the Power System elements and the total power loss for the Power System.

3. Short Circuit

a. Tabulations of short-circuit study results, including a definition of terms and guide for interpretation.

4. Protective Device Evaluation

a. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.

5. Protective Device Coordination

a. Protective device time versus current coordination curves.

b. Tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

c. Tabulation of appropriate tap settings for relay seal-in units.

6. Harmonic Study.

a. Tabulation of Harmonic Sources, including all VFDs operating simultaneously, operating over their speed range under normal and alternate operations of the Power System.

b. Branch and node voltage and current harmonic current as a percentage of the 60 Hz fundamental up to the fiftieth harmonic, inclusive of the simultaneous operation of harmonic sources to meet specific actual loadings of the Power System.

c. All calculations used to arrive at the recommendations.

d. Explanation of the methods used to perform the study.

e. Explanation of study results with specific recommendations on filters and/or other measures that will be implemented to meet the specified limits or mitigate expected resonances.

7. Diagrams

a. Single line diagram along with suitable and relevant back annotation shall be included for each alternative of the Power System studied.

b. An impedance diagram along with suitable and relevant back annotation shall be included for each alternative of the Power System studied.

8. Software Model Files

a. The Contractor shall provide two copies of the software files used to provide the Power System Studies

1) One copy of the software file shall be write-protected and shall be capable of all its elements being viewed in the software program stated in this Section.

2) The second copy of the software file shall not be write-protected and shall be capable of all its elements being modified by the software program stated in this Section.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. The Contractor shall provide field testing of the Power System.
2. All field testing shall be performed by the testing firm, after the completion and approval of the Power System Studies.
3. The field testing shall be witnessed by the Engineer and certified by the Contractor.
4. The testing firm shall adjust, set, calibrate, and test all protective devices. All protective relays and meters in the medium and low voltage equipment shall be set, adjusted, calibrated, and tested in accordance with the manufacturer's recommendations, the coordination study, and best industry practice.
5. Proper operation of all equipment associated with the device under test, and its compartment, shall be verified, as well as complete resistance, continuity and polarity tests of power, protective, and metering circuits. Any minor adjustments, repairs, and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
6. All solid-state trip devices shall be checked and tested for setting and operation.
7. Circuit breakers and/or contactors associated with the trip devices shall be tested for trip and close function with their protective device.
8. Testing shall be performed at each major node to which harmonic sources are connected to determine if the predicted recommendations of the Harmonic Study have been achieved.
9. Test will measure and compare the harmonic levels with respect to those detailed in the Harmonic Study.
10. All harmonic levels of voltage and current which do not meet the recommendations of the Harmonic Study shall be corrected at the Contractor's expense.
11. All tests shall be in accordance with the manufacturer's recommendations and NETA, ATS.

12. The Contractor shall provide a field-testing report. The report shall be in accordance with NETA, ATS.

3.04 STARTUP / DEMONSTRATION

A. Maintenance of Operations

1. Since the field-testing Work specified shall require that equipment be taken out of service, the Contractor shall perform field testing with due regard to maintenance of operations and construction staging in accordance with this Section and the Contract Documents.

2. All testing procedures and schedules must be scheduled in advance prior to any Work beginning.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 75 – SHOCK HAZARD AND ARC FLASH STUDIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing Shock Hazard and Arc Flash studies: Studies for determining Shock Hazard Boundaries and Arc Flash Incident Energies, in and around all electrical equipment, and notifying all personnel of boundaries and energies, shall be provided in accordance with the requirements of the Contract Documents and this Section.

B. The Shock Hazard and Arc Flash Studies shall include a short circuit study and a protective device coordination study. Approval shall be obtained for the use of information from existing short circuit and protective device coordination studies.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 53 - Identification for Electrical Systems

B. Section 26 05 73 - Power System Studies

1.04 REFERENCES

A. Definitions

1. AC - Alternating Current
2. DC - Direct Current
3. Electric Utility or Utility - Consolidated Edison Company of New York
4. Arc Flash Studies - Shock Hazard and Arc Flash Studies
5. AFIE - Arc Flash Incident Energy
6. SHB - Shock Hazard Boundary
7. PE or Professional Engineer or Licensed Engineer - Licensed Professional Engineer in the State of New York

B. Reference Standards. The Shock Hazard and Arc Flash Studies shall comply with the latest applicable provisions and recommendations of the following:

1. ANSI Z535.4 - Product Safety Signs and Labels
2. BWT Arc Flash - Arc Flash Personal Protective Equipment BWT Guidelines.
3. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
4. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
5. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power System Analysis
6. IEEE 1015 - IEEE Recommended Practice for Applying Low-Voltage Breakers Used in Industrial and Commercial Power Systems
7. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations
8. IEEE C37.04 - IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
9. IEEE C37.010 - IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
10. IEEE C37.13 - IEEE Standard for Low-Voltage Power Circuit Breakers used in Enclosures.
11. NFPA 70E - Standard for Electrical Safety in the Workplace
12. NYCEC - New York City Electrical Code

13. OSHA 1910 Subpart S - Electrical

1.05 DESCRIPTION

A. AC Arc Flash Study Outline. The AC arc flash study shall be conducted on all electrical equipment powered by AC sources. The equipment to be studied shall include all electrical equipment from the Electric Utility Point of Service (POS) to the electrical energy utilization point. This includes but is not limited to:

1. All sources of energy including the electric utility, alternative energy sources, emergency generators, legally required generators, optional standby generators, and motors.
2. All medium and low-voltage equipment inclusive of equipment of nominal operating voltage less than 120 VAC.
3. All medium and low-voltage electric distribution equipment, including but not limited to, switchgears, current limiting reactors, motor control centers (MCC), distribution and lighting panelboards, automatic transfer switches (ATS), and control panels.
4. All feeder and branch circuits.
5. All protective devices.

B. DC Arc Flash Study Outline. The DC arc flash study shall be conducted on all electrical equipment powered by DC Sources. The equipment to be studied shall include all electrical equipment from DC sources to the electrical energy utilization point. This includes but is not limited to:

1. Identify DC Sources
2. Identify DC Utilization Equipment

C. Arc Flash Study Modes

The arc flash study shall be conducted for different modes of electric equipment operation and the modes producing the most severe arc flash incident energy and the most restrictive shock hazard boundary shall be selected for the display on the required labels. Modes will be as directed by the Engineer but at a minimum shall be as listed below:

1. Mode 1 – All electric utilization equipment which are normally operated, are in the ON STATE, and connected in their normal configurations to the normal sources. In the normal configuration, devices such as tie breakers which are normally in the open state remain in the open state for this mode.
2. Mode 2 – As Mode 1 but with all electric utilization equipment in the OFF STATE.
3. Mode 3 – All emergency and standby electric utilization equipment are in the ON STATE and connected to sources activated by the loss of the normal sources.

4. Mode 4 – As Mode 3 but with all emergency and standby electric utilization equipment in the OFF STATE.

1.06 QUALITY ASSURANCE

A. General:

1. Arc Flash Studies shall be completed using the approved computer software programs detailed in this Section.

2. Arc Flash Studies completed manually will not be accepted.

3. The Arc Flash Studies shall be performed in accordance with the latest applicable provisions and recommendations of the Reference Standards listed in this Section.

4. The Contractor shall retain the services of a Licensed Professional Engineer to perform Arc Flash Studies. The Licensed Engineer shall be from an independent engineering firm, or as directed by the Engineer. The Licensed Engineer shall have at least five (5) years' experience in conducting Industrial Power System Studies inclusive of Arc Flash Studies for projects of similar scope.

5. The Contractor shall coordinate with the Licensed Engineer performing the studies, whether or not the Licensed Engineer has been selected by the Contractor, and assist the Licensed Engineer in the collection of all information necessary to complete the studies specified.

1.07 SUBMITTALS

A. Submittals General

1. Contractor shall submit working drawings, Shop Drawings and material specifications for the approval of the Engineer in accordance with the requirements of this Section and the Contract Documents.

a. Qualifications of proposed Licensed Professional Engineers/ Engineering firms that will conduct arc flash studies shall be submitted.

1) Submit firm experience records demonstrating at least five (5) years conducting power system studies inclusive of shock hazard and arc flash studies, along with the contact information of five (5) references for installations where arc flash studies have been completed.

2) The contact information shall include name, phone numbers, email addresses, and physical addresses of the references.

3) The contacts shall be able to speak about the work done at the reference locations.

b. Confirmation of the name and version of the approved software package that will be used in the Arc Flash Studies. The software

package shall be capable of producing samples of all equipment labels recommended, even if final labels will be produced by a third party vendor.

c. Calculations and results of the arc flash studies shall be submitted. The arc flash studies shall be submitted in a report format. The report shall contain recommended samples of the labels required for each type of equipment where personnel shall be required to interface with electrical equipment for operation, adjustment, repair, or modification. The report shall be stamped and signed by the Licensed Engineer.

d. Electronic copies of the results of the arc flash studies shall be submitted in addition to the above report. The format of the electronic submissions files shall permit and allow the following:

1) The review of all submittals in the approved software program detailed in this Section.

2) The review of all submittals by common readers such as Adobe Acrobat.

e. Work sequence for the application of equipment labels shall be submitted. The sequence shall indicate the schedule of Work, time frame, and downtime – if any – for the equipment. The Work sequence shall be submitted at least 45 days in advance prior to confirmation of field labeling dates.

B. Preliminary Arc Flash Studies

1. Preliminary Arc Flash Studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment Shop Drawings and/or prior to release of equipment drawings for manufacturing. If completion of the preliminary study may cause delays in equipment shipments, approval from the Engineer shall be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. Final formal arc flash studies shall be provided to verify preliminary findings.

C. Label Application Reports

1. A report shall be submitted detailing the equipment labeled and whether it was not possible to accomplish the labeling of specific pieces of equipment and the reasons for this.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Arc Flash Study computer software shall be as manufactured by

1. Power Analytics Corporation, Raleigh NC;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Shock Hazard Study

1. For each piece of equipment, a shock hazard analysis complying with the requirements of NFPA70E shall be completed and shall detail the following as minimum:
    a. Equipment and subpart if applicable
    b. Nominal voltage
    c. Restricted approach boundary
    d. Limited approach boundary
    e. Flash protection boundary
    f. Short Circuit Amps
    g. Protective Device clearing time.

B. Arc Flash Study

1. The Arc Flash analysis shall cover the Modes of operation detailed in this Section, ensuring that each node is studied for each maximum and minimum short circuit contribution of the energy sources connected to the system. The following shall be completed:
    a. Confirm the results of Section 26 05 73 - Power System Studies
    b. Extend the results of Section 26 05 73 - Power System Studies as required to complete the arc-flash study
    c. Calculate the arc fault currents
    d. Determine the protective device operating times

e. Determine the incident energies

f. Determine the flash protection boundaries

g. Determine the incident energies at the boundaries determined in the shock hazard analysis and at the working distance.

h. Determine the Hazard/Risk categories at the boundaries determined in this Section.

i. Recommend the appropriate required level of PPE for workers within the flash protection boundaries, the shock hazard boundaries and the working distance.

C. Reports

1. A report shall be submitted detailing the results of this study, and color copies of labels that will be prepared for each piece of equipment. The report shall contain at the minimum the following information:

a. Executive Summary including Introduction, Scope of Work and Results/Recommendations

b. All raw data collected and organized by common category

c. Study One Line Diagrams for each configuration

d. Impedance Diagrams for each configuration

e. Complete Fault and Protective Device Coordination Study

f. Shock Hazard/Arc Flash Analysis results, inclusive of tabular listing showing for each piece of equipment the following minimum information:

1) Equipment and Subpart

2) Nominal Operating Voltage

3) Restricted Approach Boundary

4) Limited Approach Boundary

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Approval Data Sources

1. The Contractor shall ensure that all other provisions of the Contract are satisfied inclusive of all vendors of electrical equipment has been approved, all working drawings and as built data relating to all equipment submitted and approved.

2. The Contractor shall ensure that the results of Section 26 05 73 – Power System Studies have been submitted and the settings of all protective devices have been approved.

3. The Contractor shall not commence the arc flash study until all prior studies and submittals to be reused in the arc flash study has been submitted and approved.

4. Arc Flash studies based on equipment or equipment data and settings which have not been approved, as required in an earlier stage of the Project, will be rejected outright.

B. Data Collection and Modelling

1. The Contractor shall ensure that the collection of all data required to support studies under Section 26 05 73 – Power System Studies and Studies under this Section are input into a comprehensive and accurate software model of the electrical distribution system.

2. Data shall include but not be limited to:

a. Maximum and minimum short circuit infeed data of all sources including current magnitudes, X/R ratios and sequence values.

b. Information on all installed equipment such as cable lengths, cable sizes, and cable impedance per unit length.

c. All data to determine clearing times of protective devices.

3. An accurate and comprehensive model of the electrical distribution system shall permit the evaluation of the short circuit currents at all nodes in the system. The model shall also permit the coordination of protection devices installed at nodes upstream and downstream of a specific node.

4. All nodes incorporated in the model shall be approved before any analyses are commenced.

3.02 INSTALLATION

A. Arc Flash Labels

1. Arc Flash labels shall be provided in accordance with Section 26 05 53 - Identification for Electrical Systems.

2. The Contractor shall affix arc flash labels to each piece of equipment.

3. The arc flash labels shall contain the results of this Section.

4. The label content and the schedule governing the placement of labels shall be approved by the Engineer before affixing the labels to the equipment.

5. Each label shall indicate location in the facility of a copy of the studies generating the labels.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Training

1. The Contractor shall conduct training of the owner's qualified electrical personnel on the potential arc flash hazards associated with the working of the energized equipment.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 91 – LOW-VOLTAGE ELECTRIC MOTORS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing low-voltage electric motors. Low-voltage electric motors shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	16
2.04	Source Quality Control / Shop Tests	16
PART 3	EXECUTION	18
3.01	Examination / Preparation	18
3.02	Installation	18
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	19
3.05	Adjusting / Protection / Cleanup	20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 05 97 – Identification for Process Equipment.

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation within the 600 Volt Class.

B. Reference Standards

1.	AFBMA Standard 9	-	Load Ratings and Fatigue Life for Ball Bearings.
2.	AFBMA Standard 11	-	Load Ratings and Fatigue Life for Roller Bearings.
3.	API Standard 541	-	Form-Wound Squirrel-Cage Induction Motors 375 kW (500 HP) and Larger
4.	EPAct 1992	-	Energy Policy and Conservation Act of 1992
5.	EISA 2007	-	Energy Independence and Security Act of 2007
6.	IEEE 112	-	IEEE Standard Test Procedure for Polyphase Induction Testing Motors and Generators.
7.	IEEE 841	-	Premium-Efficiency, Severe Duty Totally Enclosed Fan-Cooled Squirrel-Cage Induction Motors.
8.	NEMA MG1	-	Motors and Generators.
9.	NEMA MG 10	-	Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors.
10.	NETA ATS	-	Acceptance Testing Specifications.
11.	NIST	-	US National Institute of Standards and Technology
12.	NYCEC	-	New York City Electrical Code.
13.	NYC EPPR	-	New York City Environmentally Preferable Purchasing Rule.
14.	UL Standard 674	-	Low-voltage electric motors and Generators for use in Hazardous Locations.
15.	UL Standard 1004	-	Low-voltage electric motors.

1.05 DESCRIPTION

A. Motor Data

1. Motor data is specified under the Section of the Contract Documents detailing the requirements of the driven equipment with which the motor is supplied. These data include voltage, rpm, HP and enclosure types

B. Motor Types

1. The motor types specified under this Section shall include:

a. Single Phase, alternating current, fractional horsepower induction motors.

b. Three Phase, alternating current, NEMA frame, squirrel cage, induction motors.

c. Three Phase, alternating current, above NEMA frame, squirrel cage, induction motors.

d. Three Phase, alternating current, submersible, squirrel cage, induction motors.

e. Three Phase, alternating current, wound-rotor, squirrel cage, induction motors.

f. Direct current, small motors.

1.06 QUALITY ASSURANCE

A. Electric Motors shall comply with the requirements of NYC EPPR.

B. The motor manufacturer shall maintain a documented Quality Assurance Program implementing suitable procedures and controls to monitor all aspects of production and testing.

C. The Quality Assurance Program shall be the manufacturer's standard program specifically dedicated to ensure each motor is designed, assembled, and tested in accordance with the requirements specified in this Section and the Contract Documents.

D. Motor manufacturer shall use a shop test facility that has calibrated testing apparatus, inclusive of a calibrated dynamometer and qualified experienced technicians for all shop tests. Calibration of all testing apparatus shall be within one year.

E. All test equipment, instrument calibration and test reports shall be in accordance with the latest edition of the accuracy standard of The U.S. NIST and NETA ATS.

F. Nameplates shall be provided for each motor. Nameplates shall clearly indicate information in accordance with NEMA requirements. Nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins.

G. Field Tests:

1. The motors shall be field tested.

2. Field testing shall be performed in accordance with the requirements specified under this Section and the Contract Documents.

3. Retain the services of the motor manufacturer for field service.

4. Field service shall be in accordance with the requirements specified under this Section and the Contract Documents.

5. For motors larger than 200 horsepower an independent testing firm shall be retained to perform acceptance testing of the motors.

   a. The testing firm shall have experience in the inspection and testing of motors and shall be a member company of NETA.

   b. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

   c. Acceptance testing shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. A list of proposed manufacturers, with the products they produce, proposed for the Contract.

2. For fractional horsepower motors, data sheets showing nameplate data shall be submitted.

3. For motors rated one horsepower or greater, Motor Test Data Sheets shall be submitted. All values shall be from tests of previously manufactured, electrically duplicate motors or calculated data. Sheets shall be marked to indicate motor application location, manufacturer, type, frame size, bearing type, lubrication medium and enclosure type. Data Sheets shall at a minimum include:

   a. Winding resistances.

   b. Torques.

   c. Efficiencies.

   d. Power factors.

   e. Slip.

   f. Full load.

   g. Locked rotor and no load amperes.

   h. Rotor voltage and amperes for wound rotor units.

   i. Nameplates temperature and results of dielectric tests.

4. An outline drawing or an outline data sheet showing complete motor dimensions shall be submitted to cover every motor rated greater than 1/3 horsepower. Several motors of the same type and rating for the same application may be covered by a single drawing or outline sheet. Drawings or sheets shall bear complete identifying data including frame size, speed, horsepower ratings, and application for each particular unit.

5. Description of proposed shop and field testing methods, procedures, and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted in advance prior to conformation of witness testing dates and actual testing as follows:

   a. At least 60 days in advance for test locations in the US.

   b. At least 90 days in advance for test location outside of the US.

6. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 60 days in advance to actual testing, five recent references with phone numbers shall be submitted.

7. All motor accessories, heaters, detectors, etc., shall be submitted.

8. Bill of Materials for the proposed motors shall be submitted.

B. Certificates of Compliance:

1. Certified copies of motor characteristic curves and all other data necessary for establishing control and protective equipment settings shall be submitted.

2. Results of shop tests shall be certified. When routine tests are made in conjunction with complete initial tests, unwitnessed results shall be certified and copies shall be submitted. Results shall be included for each test.

3. Data and results of witness tests shall be submitted with copies of certified initial tests, accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to site shall proceed and the Engineer shall be notified of the arrival date.

C. Reports:

1. Shop test and field test reports shall be submitted.

2. Manufacturer’s site visit and acceptance testing reports shall be submitted.

D. Operation and Maintenance Manuals.

1. Operation and Maintenance Manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Low-voltage electric motors shall be delivered, stored, and handled in accordance with this Section, the Contract Documents, the motor manufacturer's instructions and the following:

1. Motors shall be inspected for shipping damage when received.

2. All sleeve or oil lubricated bearings motors shall be identified and the bearing reservoirs filled to normal level.

3. Motors shall be handled using motor base lifting lugs. Avoid pounding or bumping of motor which may damage motor. A hoist and spreader bar arrangement shall be used to avoid damage.

4. Motors shall be stored indoors in clean, dry heated areas.

5. Motor space heaters shall be energized to prevent moisture condensation throughout the storage and construction period.

6. Motors shall not be stored in areas subject to continuous vibration. A small quantity of grease shall be injected into each bearing on a monthly basis. Purged grease shall be inspected for water or rust. Motor shaft shall be rotated by hand to check for binding.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Spare Parts

1. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for the low-voltage electric motors in accordance with this Section and the Contract Documents.

2. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

3. Spare parts shall be furnished in accordance with the manufacturer's recommendations for the motor size and type. Spare parts shall include at a minimum the following:

a. One complete set of bearing linings, or renewable ball or roller bearings shall be provided for each three (or less) of each type and size of motor. Spare bearings shall be furnished for all motor types. When sleeve bearing motors are provided, spare oil rings shall be furnished for those motors.

b. One set of brushes shall be provided for each DC type motor and wound rotor type motor requiring them.

c. One complete assembly of brush holders and supports shall be provided for each size of DC type motor and wound rotor type motor requiring them.

d. One complete assembly of collector rings shall be provided for each size of wound rotor type motor requiring them.

e. One complete set of fans and guards shall be provided (per each set of three or less) for each size totally enclosed fan cooled type motor.

f. One set of bearing temperature detectors shall be provided (per each set of three, or less) of each type of motor 250 horsepower and larger.

g. One set of upper and outer seal assemblies shall be provided (per each set of three or less) for each size submersible type motor.

h. One set of O ring kit shall be provided (per each set of three or less) for each size submersible type motor.

i. One set of wear rings shall be provided (per each set of three or less) for each size submersible type motor.

B. Lubricants

1. The Contractor shall furnish as part of the bulk lubricant order the quantity of lubricants required to operate and maintain the motors furnished under this section for a period of one year after acceptance. As a minimum, there shall be provided sufficient oil and grease to make a least one lubricant change for each motor as applicable.

2. Replace all lubricants used during startup and testing prior to acceptance of equipment. Furnish this replacement lubricant in addition to the lubricants included in the bulk order.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Driven Equipment

1. The motor manufacturers are as shown on the Contract Drawings or stated in the Sections detailing the driven equipment.

2.02 MATERIALS / EQUIPMENT

A. Design Requirements

1. Motors shall be designed, built, and tested in accordance with the latest applicable editions of ANSI/IEEE, NEMA, UL and NYCEC. The classifications, ratings, performance and testing of all motors shall be in accordance with the latest edition of NEMA MG1.

2. Motor winding shall be copper.

3. Motors shall be premium efficiency type and shall have nominal efficiencies in accordance with NEMA MG1. Motors with horsepower or rpm's not listed by NEMA shall conform to comparable standards of construction and materials as those for listed NEMA motors.

4. Motors shall be of sufficient capacity to operate the driven equipment under all conditions of operation without loading the motors beyond their rated nameplates current and power under all operating conditions imposed by the driven equipment.

5. The rating of the motors offered shall in no case be less than the horsepower shown on the Contract Drawings or stated in the Contract Documents. Both the rating and the characteristics of the motor shall be suitable for the successful operation of the driven equipment, under load conditions, within nameplates values of service factor and ambient temperatures.

6. Motors shall be of three phase construction for ratings above 1/3 horsepower and single phase construction for 1/3 horsepower or less.

7. Low-voltage motors shall be of a type approved for starting characteristics and ruggedness as may be required under the actual conditions of operation.

8. Low-voltage motors shall be designed for full voltage starting.

9. Reduced voltage starters, shall ensure that the motor develops ample torque and is able to accelerate and attain its operating speed under the load conditions imposed by the driven equipment.

10. Multi-speed motors shall have a separate winding for each speed unless.

11. Portable devices shall have totally enclosed motors and approved cord with provisions for grounding. They shall be suitable for the available power supply.

12. All motors shall be continuous time rated suitable for operation in a 40 degrees Celsius ambient.

13. Motors shall comply with the EPAct 1992 and EISA 2007.

14. Variable-speed motors shall comply with NEMA MG1.

15. Variable-speed motors operated from variable frequency drives shall comply with NEMA MG1 and shall be inverter duty rated.

B. Single Phase Motors

1. Single phase motors shall be rated 115 or 230 volt, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment.

2. Bearings for single phase, open, enclosed and explosion-proof motors shall be grease-lubricated ball type with grease fittings or with lubrication for 10 years of normal operation.

3. Motors shall be totally-enclosed except small fan motors may be open type if suitably protected from moisture, dripping water, and lint accumulation. Motor features shall be in accordance with the following:

   a. Open motors shall be split phase or capacitor start in accordance with torque requirements, 1.35 Service Factor, 40 degrees Celsius Ambient Class B Insulation.

   b. Enclosed motors shall be capacitor start, fan cooled 1.15 service factor, 40 degrees Celsius ambient, Class F, treated insulation. Enclosed motors shall be totally enclosed fan cooled, or non-ventilated. Enclosed motors shall be designed to withstand chemical corrosion and shall be severe duty type equipped with cast iron end shields, neoprene gaskets, stainless steel shaft, heavy pressed steel fan cover and provision for threaded conduit connection.

   c. Explosion-proof motors shall be fan cooled, split phase or capacitor start in accordance with torque requirements, 1.0 service factor, 40 degrees Celsius ambient, equipped with swivel conduit connector and long leads for external connection.

   d. Direct drive fan motors shall be shaded pole or permanent split capacitor, 1.35 service factor, 40 degrees Celsius ambient.

C. Three Phase Motors

1. General

   a. Three phase motors shall be squirrel cage induction type, designed for operation on a 3 phase, 60 hertz alternating current system.

   b. Three phase squirrel cage motors shall be severe duty and shall conform to the requirements of IEEE 841

   c. Motor voltage shall be as shown on the Contract Drawings.

   d. Motors used with adjustable frequency controllers shall be as stated in this Section, and the Contract Documents.

   e. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque. Locked rotor KVA/HP shall not exceed NEMA Code Letter G for 20 HP motors and larger.

   f. The design of the stator, rotor and shaft shall be in accordance with the approved practice of leading manufacturers. The motor frame shall be a rigid structure, designed to maintain the lamination in correct alignment and shall not be dependent on the lamination or bolts for rigidity.

   g. Motors having considerable core length shall be provided with approved means for taking up shrinkage in length.

h. Motor rotors shall be of cast or fabricated aluminum or fabricated copper or copper alloy as required to meet the motor performance characteristics of slip, torque, and efficiency.

2. Bearings

a. Horizontal motors shall be provided with either the rolling element (anti-friction) or sliding element (sleeve) type bearings. Anti-friction type bearings shall be used for all NEMA frame motors. Where greater power and speeds are required by the driven equipment, sleeve type bearings shall be used. The bearings for all motors larger than 200 horsepower shall be insulated to prevent shaft currents and related bearing damage.

b. Bearings for three-phase drip-proof, enclosed, and explosion-proof motors shall be grease lubricated, ball type. Bearings shall be fitted with inlet fittings and outlet plugs. Motor bearings and grease reservoirs shall be protected from the entry of contaminants.

c. Bearings for direct drive fan motor shall be of the oil lubricated sleeve type.

d. When anti-friction bearings are furnished on horizontal motors for ratings to 500 horsepower and speeds to 3600 RPM they shall have a minimum bearing life of 100,000 hours as defined by AFBMA. Suitable fittings shall be provided to permit convenient positive purging of old grease during regreasing operation. Close running shaft seals shall prevent leakage of grease as well as prevent the entrance of foreign materials such as water and dirt into the bearing area. Motors equipped with anti-friction bearings shall have the appropriate AFBMA number stamped on a nameplate attached to the motor.

e. When furnished, sleeve bearings shall be ring-oiled with an adequate, integral self-cooled oil reservoir. The bearing sleeves shall be lined with a high tin content babbitt to minimize oil contamination. Close running shaft seals shall prevent oil leakage as well as prevent entrance of foreign material such as water and dirt into the bearing area. Oil level sight gages with permanently marked easily discernible oil level shall be provided. In addition, inspection openings to observe the oil rings shall also be provided.

f. When required by motor speed and bearing size, provision shall be made for forced lubrication. The oil supply shall be supplied with motor. In addition, oil rings and an adequate oil reservoir in the bearing housings shall be provided to permit orderly shutdown of the motor in the event of failure of the formed feed lubrication system.

g. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected. The rated minimum life of the thrust bearings shall be at least 15,000 hours when operated at rated speed and full load thrust. The driven equipment manufacturer shall supply the motor manufacturer with the speed and thrust conditions required by the driven equipment.

h. Submersible motor bearings shall be permanently sealed and lubricated. Anti-friction guide and thrust bearings shall be replaceable. Bearings shall have a rated minimum life of 15,000 hours.

3. Insulation

a. The insulation system for three phase AC motors shall be rated Class F, with a service factor of 1.15 times the nameplate horsepower rating when operated on a sine wave supply and a service factor of 1.0 on an adjustable frequency supply. Temperature rise shall be limited to Class B insulation system when motor is operated continuously at rated horsepower with an ambient temperature not exceeding 40 degrees Celsius.

b. Windings shall be epoxy coated. The windings shall be thoroughly treated with approved insulating compound suitable for protection against moisture, salt air and slightly acid or alkaline conditions. The insulation system for enclosed motors shall be upgraded by additional dips and bakes to increase moisture resistance.

c. Motors for outdoor service and all motors larger than 200 horsepower shall have vacuum/pressure impregnated epoxy insulation (VPI) for moisture resistance. Motors shall be preheated before VPI and baked in a temperature-controlled oven.

d. Motors applied in speed varying service and operated from variable frequency controllers shall have an inverter grade insulation system designed and built in accordance with NEMA MG1 Part 31.

e. The stator windings and end turn connections shall be fully brazed to withstand full voltage starting regardless of the starting method indicated in this Section, and the Contract Documents. The bracing system shall essentially eliminate coil vibration under the high current conditions of starting as well as during normal operation. If a tied system is used, it shall be such that no tie depends on the integrity of any other tie within the system.

f. Motors larger than 200 horsepower shall be form wound. Form wound coils with a micaceous ground wall insulation is required with additional insulation similar to Mica 5 and hot pressed to make a sealed system. Coils shall be form wound with mica insulation

and each separate coil shall be vacuum pressure impregnated before inserting into slots.

4. Enclosures

a. Wound rotor motors shall be drip-proof, except for crane and hoist installations and where specified otherwise.

b. Motors shall have a steel or cast iron frame and a cast iron or steel conduit box. For wound rotor motors separate boxes for stator and rotor connections shall be provided. For NEMA frame size motors cast aluminum frames and terminal boxes may be used.

c. Motor enclosures shall conform to the NEMA classifications specified and to the following:

1) Open Drip proof: Motors shall have a steel or cast iron frame, cast iron end brackets and steel conduit box. Vertical motors of the open type shall be provided with drip hoods of approved shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing. Open motors shall be provided with corrosion resistant screens over the air openings in accordance with NEMA requirements for guarded machines.

2) Totally enclosed fan cooled and non-ventilated motors shall have a cast iron frame, cast iron end brackets and cast iron conduit box. Drain holes shall be provided on each end of motor.

3) Explosion proof motors shall have a cast iron frame, cast iron end brackets and cast iron conduit box. Unless otherwise stated/shown in the Contract Documents the, explosion proof motors shall be UL listed for Class 1, Division 1, Group D hazardous areas.

4) Severe duty motors shall include a corrosion resistant treatment. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box, stainless steel "T" drains in both end brackets, corrosion resistant fan, and stainless steel hardware.

5) Submersible motors shall be hermetically sealed, watertight with tandem mechanical seals suitable for continuous submergence and listed for Class 1, Division 1, Group D locations.

d. Conduit Boxes

1) Motor conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Motor conduit box shall be in accordance with the following:

a) Conduit box shall be gasketed and shall include rubber-like gaskets between the frame and the conduit box and between the conduit box and its cover.

b) Conduit boxes or openings in motor housings shall be provided with conduit hub type fittings to permit threaded conduit connections. Single phase, explosion-proof and direct drive fan motors shall be provided with conduit fittings and leads to permit external connection.

c) Conduit box sizes shall be in accordance with code requirements. This shall include appropriate terminations for the rated voltages.

d) Protective and auxiliary devices, shall terminate in auxiliary conduit boxes.

e) Terminal leads shall be flexible and shall be of sufficient length to extend for a distance of not less than ten inches beyond the face of the terminal box. Terminal leads shall be fitted with solder less lugs suitable for attachment to lugs installed on external wiring. Leads shall be sealed with a non-wicking, non-hygroscopic insulating material or an insulating "wrap-cap".

f) Provisions for terminal box size, length of leads, size of conduit openings and type of terminal lugs shall be complied with irrespective of any other standards or practice.

g) A motor frame grounding stud shall be provided inside the conduit box. A drilled and tapped hole shall be included.

D. DC Motors

1. General

a. DC motors shall be designed and built in accordance with NEMA Standard MG1-12 for use on a full wave, single phase, rectified power supply.

b. DC motors shall be heavy duty, industrial SCR drive type, direct current. Motor construction shall be shunt-wound or permanent-magnet type as stated in this Section, and the Contract Documents.

c. DC motors shall provide a constant torque output over the operating speed range, with fixed shunt excitation and variable DC armature voltage.

2. Bearings shall be grease lubricated, double shielded, with shaft seals.

3. Insulation

   a. The insulation system for DC motors shall be Class F, with a service factor of 1.15 times the nameplate horsepower rating.

   b. The windings shall be epoxy coated and include a thermostat protector. Thermostat shall be in accordance with the requirements specified under this Section.

4. Enclosures

   a. DC motor enclosure shall be totally enclosed fan cooled, or non-ventilated. The frame size shall be selected by the manufacturer to prevent overheating when continuously operated at low speeds.

   b. Motor enclosures shall be severe duty type, designed to withstand chemical corrosion, and shall utilize corrosion resistant materials for special finishes in their construction. Motors shall be equipped with cast iron end shield, neoprene gaskets, stainless steel shaft, heavy pressed steel fan cover and provisions for threaded conduit connection.

   c. When stated in this Sections and the Contract Documents, the motor enclosure shall be fitted with a factory mounted tachometer generator. The generator shall be C-face or flange mounted construction.

E. Accessories

1. General

   a. Motor accessories shall be provided in accordance with the requirements specified under this Section, the Specifications and the Contract Drawings.

2. Rotor Grounding

   a. An approved rotor grounding means or mechanism shall be provided to drain induced currents, parasitic and static charges to ground.

3. Space Heaters

   a. Each outdoor motor 5 horsepower and larger shall be provided with space heaters.

   b. Each motor 5 horsepower and larger enclosed motors installed indoors, in damp unheated spaces, shall also be provided with space heaters.

4. Each motor 250 horsepower and larger shall be provided with space heaters.

5. Space heaters for condensation prevention shall be rated 120 volt. Wattage shall be suitable for the particular frame size and type in accordance with the manufacturer's recommendation.

6. Space heater wire leads shall be brought out to an auxiliary conduit box on the motor. Box construction shall match main power conduit box.

F. Winding Protection

1. Winding Protective Devices:

a. Thermostat type protection shall be provided for each motor in accordance with the following:

1) Submersible motors and explosion proof motors.

2) Variable speed motors up to 25 horsepower.

b. Thermistor type protection shall be provided for each motor in accordance with the following:

1) Constant speed motors 50 horsepower and larger up to 200 horsepower.

2) Variable speed motors 30 horsepower and larger up to 200 horsepower.

c. Resistance temperature detectors shall be 100-ohm precision type with calibrated resistance-temperature characteristics. Detectors, two per phase, shall be positioned to detect highest winding temperature and located between coil sides in stator slots. Detector leads shall be wired to a separate NEMA 4X terminal box.

2. Thermostats shall be bi-metal disk or rod type embedded in the stator windings. Thermostat contacts shall be automatic reset type, rated 120-volt AC, 5 amps minimum opening on excessive temperature.

3. Thermistors embedded in each stator phase winding shall be in direct contact with the winding conductors. Each thermistor circuit shall be factory wired to 120-volt solid state control module mounted at the motor in a NEMA 4X box. The control module contacts shall be automatic reset type, rated 120-volt AC, 5 amps minimum opening on excessive temperature.

G. Bearing Temperature Protection

a. Bearing temperature detectors, RTD type similar to the winding detectors specified under this Section shall be provided on each bearing for horizontal motors and on the thrust bearing for vertical motors.

b. Each motor 250 horsepower and larger shall be provided with stator and bearing temperature detectors.

H. Special Application

1. Cranes, elevators, hoists, and other devices complying with special safety codes shall be furnished complete with their control equipment, and with all accessories and safety devices for approved safe and efficient operation.

I. Single Phase Motors

1. Single phase motors requiring auxiliary starting resistors, capacitors or reactors and switching devices shall be furnished as combination units with such auxiliaries either incorporated within motor housings or housed in suitable enclosures, mounted upon motor frames. Each combination unit shall be mounted upon a single base and shall be provided with a single conduit box.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. External Surfaces:

a. All severe duty motors shall have all external surfaces pretreated, primed and painted. External surfaces shall be pretreated so the surface is clean and free of contaminants. After pretreatment, the surface shall be primed with an oxide primer and then spray painted with a minimum of 0.003-inch thick epoxy polyamide and semi-gloss coating that is chemical, solvent, salt water, and acid resistant.

b. All other motors shall have external surfaces pretreated, primed and painted in accordance with the manufacturer's standard treatment.

2. Internal Surfaces:

a. All severe duty motors shall have all internal surfaces pretreated, primed and painted. Internal surfaces shall be pretreated so the surface is clean and free of contaminants. After pretreatment, the surface shall be primed with an oxide primer and then painted with an epoxy paint. Machined joints and threaded parts shall be coated with rust inhibiting compound.

b. All other motors shall have internal surfaces pretreated and primed in accordance with the manufacturer's standard treatment.

B. Hardware

1. All machined bolts and screws and other hardware shall be of the hex head type and shall be zinc plated.

2. Stainless steel hardware shall be used on severe duty motors.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the motors at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of IEEE 112 and NEMA MG1 and shall demonstrate that the equipment

tested conforms to the requirements specified inclusive of the efficiency requirements stated in this Section.

2. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

3. Every motor rated less than 200 horsepower shall be given a routine test at the manufacturer's factory. The routine test shall consist of:

   a. No Load Speed, Voltage and Current at rated frequency.

   b. Locked Rotor Current.

   c. Winding Resistance.

   d. High Potential.

   e. Bearing Inspection.

   f. Measurement of Secondary Volts at standstill for wound-rotor units.

4. Motors rated at 200 horsepower or greater shall be given complete initial tests consisting of:

   a. Full-load Heat Run.

   b. Percent Slip.

   c. No Load Speed, Voltage, Current and losses at rated frequency.

   d. Full Load Current.

   e. Locked rotor Torque.

   f. Locked-rotor Current.

   g. Breakdown Torque (Calculated).

   h. Starting Torque (squirrel-cage).

   i. Winding Resistance.

   j. High Potential.

   k. Sound.

   l. Vibration.

   m. Efficiencies at 125, 100, 75 and 50 percent of full load.

   n. Power Factors at 125, 100, 75 and 50 percent of full load.

   o. Bearing Inspection.

   p. Measurement of Secondary Volts at collector rings for wound-rotor units.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with this Section and the Contract Documents.

2. When stated in this Section and the Contract Documents, motors shall be witness tested. Motors shall be given a complete test two weeks before and then retested in the presence of the witness.

3. When complete initial or witness tests are required for a group of the same type, rating and horsepower for the same application, all units of the group shall be subjected to the complete test, unless specifically stated otherwise in this Section or the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Motors

1. Motors shall be installed in accordance with manufacturer's instructions and recommendations.

2. Each motor shall be carefully and properly aligned with the driven equipment.

3. Equipment shall be secured to mounting surface with anchor bolts. Anchor bolts shall be provided meeting manufacturer's recommendations and of sufficient size and number to secure equipment.

4. Motor nameplates shall be installed for identification of equipment. Nameplates shall be provided in accordance with the requirements of Section 40 05 97 - Identification for Process Equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, motors shall be field tested for operation and conformance. The Contractor shall perform field tests in accordance with this Section, and the Contract Documents. The field tests shall be witnessed by the Engineer and certified by the Contractor.

2. Motor testing shall be performed by the manufacturer's representative, prior to energizing equipment.

3. Equipment shall not be energized without the permission of the Engineer.

4. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall include at a minimum the following:

a. Motors shall be checked to determine that they have been properly installed, lubricated and connected.

b. Motors shall be checked to determine they are not overloading, overheating or defective.

c. Motors shall be checked to determine they comply with performance and design parameters.

B. Manufacturer's Field Services

1. A qualified manufacturer's service representative shall assist in the installation of the motors, check the motor installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations and train the plant operations and maintenance staff in the care, operation and maintenance of the motors.

2. The Contractor shall provide equipment start-up services and training in accordance with this Section, the Specifications and the Contract Drawings.

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

4. The service representative shall sign in with the Engineer on each day they are at the site.

3.04 STARTUP / DEMONSTRATION

A. Acceptance Testing

1. The Contractor shall provide acceptance testing of the motors. All acceptance testing shall be performed by the testing firm, after the completion of the Field Tests specified under this Section. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

2. Acceptance inspection shall be performed on each motor larger than 200 horsepower. Inspection shall include the following:

a. Electrical and grounding connections shall be inspected.

b. Shaft alignment, proper mounting and lubrication shall be inspected.

c. Ventilating air passageways shall be inspected for blockage.

d. Excessive noise shall be inspected.

e. Any overheating shall be inspected.

f. Correct rotation shall be inspected.

g. Protective detectors operation shall be checked.

h. Any excessive vibration shall be checked.

i. Space heater operation shall be checked.

3. Acceptance electrical testing shall be performed on each motor larger than 200 horsepower. Testing shall include the following:

a. Insulation resistance tests shall be performed.

b. Surge comparison testing shall be performed.

c. Vibration tests shall be performed.

d. Bearing insulation resistant tests on insulated bearings shall be performed.

e. Running current and voltage shall be measured and evaluated relative to load conditions and nameplate full-load amperes.

f. High-potential tests shall be performed.

g. For wound rotor motors, additional electrical testing at minimum and normal operating load points and at ring short shall be performed.

h. Motors shall be operated with driven equipment for a minimum of 48 continuous hours and rechecked for overheating and vibration.

4. All tests and values for AC and DC motors shall be in accordance with the manufacturer's recommendations and NETA ATS.

5. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 06 11 – CABLE AND CONDUIT SCHEDULE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install wires, cables, and conduits completely and operationally.

B. All wiring, cable and conduit shall be furnished and installed under this Contract, unless specifically noted otherwise.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	3
PART 3	EXECUTION	3
3.01	Examination / Preparation	3
3.02	Implementation	3
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	4

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 14 – Medium-Voltage Cables and Accessories

B. Section 26 05 20 – Low-Voltage Wires, Cables and Accessories

C. Section 26 05 53 – Identification for Electrical Systems

1.04 REFERENCES

A. Definitions

1. Conduit shall include all types of raceways provided under this Contract.
2. Install or Installed, as applicable to Conduit, shall mean install all Conduits, raceways, fittings, boxes and accessories required to achieve a complete and functional conduit system.
3. Install or Installed, as applicable to Conduit, shall also include cleaning and swabbing, grounding, and bonding of the conduit system and the provision of drag lines in each conduit on completion of the conduit system.
4. Installed or Installed, as applicable to wire and cable, shall mean the pulling in of wires or cable, testing wire or cable insulation resistance, continuity, and absence from grounds as well as terminating of all conductors and testing for proper connection.

B. Reference Standards

1. NYCEC - New York City Electrical Code

1.05 DESCRIPTION

A. The Wire, Cable and Conduit Schedule, shown on the Contract Drawings, lists the following information:

1. Conduit number
2. Conduit size
3. Point of origination
4. Point of termination
5. Enclosed wire or cable size and the number
6. Purpose of the wire or cable contained in the conduit such as power, control, ground, etc.

B. In general, the Wire, Cable and Conduit Schedules do not indicate lighting and receptacle circuits, as well as some other wire, cable and conduit to be provided under this Contract.

C. The Contractor shall refer to Section 26 05 14 – Medium-Voltage Cables and Accessories, Section 26 05 20 - Low Voltage Wires Cables and Accessories, and Section 26 05 53 - Identification for Electrical Systems, and the Contract Drawings for additional wire, cable, and conduit requirements.

1.06 QUALITY ASSURANCE

A. All Conduits shall contain a separate equipment grounding conductor sized according to the NYCEC.

1.07 SUBMITTALS

A. Cable and Conduit Schedules shall be submitted for approval.

B. Cable and Conduit Schedules shall show all the details of all wires, cables and conduit to be installed under this Contract, including at a minimum the following information on each Conduit run:

1. Conduit Number
2. Conduit Size
3. Point of origination
4. Point of termination
5. Enclosed wire or cable size and the number and types
6. Purpose of the wire or cable contained in the conduit such as power, control, ground etc.
7. Miscellaneous information.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 08 11 – GENERAL ELECTRICAL TESTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Electrical testing shall be provided in accordance with this Section and the Contract Documents.

1. The Contractor shall provide all labor, materials, tools, instruments, power, and all services necessary to provide the tests specified for all electrical materials, equipment, and systems provided under this Contract.

2. The Contractor shall engage the services of an Independent Testing Company (ITC) to perform specific tests as detailed in this Section and the Contract Documents.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Implementation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Plant refers to facilities used for the processing and conveyance of water or wastewater and includes pump stations, water, and wastewater processing or treatment facilities.

2. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation within the 600 Volt Class.

3. Medium-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation at above 1000 volts and below 99000 volts.

4. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the Local Electric Utility having jurisdiction.

B. Reference Standards

1.	NETA ATS	-	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
2.	Infraspection Institute	-	Standard for Infrared Inspection of Electrical Systems & Rotating Equipment

1.05 DESCRIPTION

A. Upon completion of the electrical installation, the Contractor shall perform tests to demonstrate that the entire electrical system is in proper working condition and is in accordance with the Contract Documents.

1. Tests shall be as outlined in this Section and those of the individual Sections of the Contract Documents.

2. Field tests shall be in addition to the factory tests on individual items previously performed at the manufacturer's plant.

3. Perform insulation integrity tests and ground resistance tests before operating tests.

4. Determine proper rotation of motors before permanent connections are made.

1.06 QUALITY ASSURANCE

A. ITCs conducting Electrical Testing shall

a. Have a minimum of 10 years conducting tests as detailed in NETA ATS

b. Be a first tier Subcontractor.

c. Be a firm independent of any Other Contractor.

d. Be a firm independent of the Engineer or the Designer.

e. Be a NETA Accredited Company deploying NETA certified personnel.

B. ITCs conducting Thermographic Testing shall

a. Have a minimum of 10 years conducting tests as detailed by the Infraspection Institute.

b. Be a first tier Subcontractor.

c. Be a firm independent of any Other Contractor.

d. Be a firm independent of the Engineer or the Designer

e. Deploy Infraspection Institute certified personnel.

C. Calibration of Equipment

1. All test instruments and test equipment shall have been calibrated within the 12 month period immediately preceding the dates when they will be used on this Contract.

2. All test instruments and test equipment shall bear the calibration marks, stamps or seals of an approved testing body or agency with reference standards directly traceable to those held by the National Institute of Standards and Technology (NIST).

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer.

B. Submittals shall include, but not be limited to, the following:

1. Organization of the Testing Companies, inclusive of details of the specific personnel that will be utilized on specific tests.

2. Documentation detailing firm accreditation

3. Qualifications of testing personnel

4. Proposed testing methods and schedules, test setup and sample data sheets

5. Calibration Reports of test equipment

6. All field test reports.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Factory Tests

1. Factory and witnessed shop testing requirements shall be as detailed in the individual equipment Sections of the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Schedules/Scheduling

1. Written notice of the intent to proceed with any scheduled and approved tests shall be given to the Engineer at least two (2) weeks in advance of the commencement of the testing.
2. When testing requires that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval 45 days prior to the two (2) week notice above.
3. When testing has been scheduled as above, the Plant Superintendent must be notified 48 hours prior to any Work to allow time for load switching and/or alternation of equipment.
4. All testing that requires temporary shutdown of Plant equipment must be coordinated with Plant Superintendent so as not to affect proper Plant operations.
5. At the end of each workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise.
6. In addition, should an emergency condition occur during testing, at the request of either the Plant Superintendent or the Engineer or the Engineer's designated representative attending the testing, the equipment shall be placed back in service immediately and turned over to Plant.

7. In the event of accidental shutdown of Plant equipment, the Contractor shall notify Plant Superintendent or the Engineer or the Engineer's designated representative immediately to allow for an orderly restart of affected equipment.

3.02 IMPLEMENTATION

A. Test Personnel/Test Equipment

1. The Contractor, and where applicable in conjunction with the ITC, shall furnish all instruments and qualified personnel for all tests.

B. Attendance at Tests

1. All tests shall be made in the presence of the Engineer or a duly authorized representative of the Engineer.

2. A manufacturer's representative in accordance with the requirements of the specific equipment Section shall be present at all equipment tests

3. When the presence of the Engineer or the Engineer's representative is waived, sworn statements, in duplicate, of the tests made and the results thereof shall be furnished to the Engineer by the Contractor.

4. A manufacturer' representative

C. Tests/Testing by Others

1. The Electrical Contractor shall make available the electrical system and personnel when required by other Contractors to test their respective equipment.

2. The Electrical Contractor shall coordinate their resources with the other Contractors.

3.03 FIELD TESTING / QUALITY CONTROL

A. Non ITC Testing

1. The Contractor shall complete all testing not required to be completed by an ITC including:

a. All low-voltage equipment testing.

b. All raceway testing not requiring the use of medium-voltage test methods.

c. All low-voltage cable testing utilizing low-voltage or extra-low voltage methods.

d. All phasing verifications utilizing low-voltage or extra-low voltage methods.

e. All continuity testing utilizing low-voltage or extra-low voltage methods

f. All ground system bonding and continuity testing utilizing low-voltage or extra-low voltage methods.

g. All low-voltage voltage and potential testing and verifications.

B. ITC Testing

1. An independent testing company comprised of NETA certified test personnel and project administrators shall be retained by the Contractor to complete the following:

a. All medium-voltage equipment testing.

b. All medium-voltage cable testing.

c. All dielectric tests.

d. All low-voltage and medium-voltage protective device testing and setting related to Arc Flash Studies.

e. All low-voltage and medium-voltage Protective Device testing and calibration.

f. All potential and current transformer testing and determination of performance curves.

g. All Primary and Secondary injection tests of protective device systems.

h. All ground systems testing.

2. Thermographic Testing and Imaging

a. An independent testing company comprised of Infraspection Institute certified test personnel and project administrators shall be retained by the Contractor to complete the following:

1) All thermographic testing of electrical equipment.

2) As required by specific Sections.

b. The level of plant loading of equipment subject to Thermographic Testing shall be as specified in the equipment Section but shall not less than 60 percent of the rated equipment load.

C. Final Field Testing

1. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the startup and testing of all other Work of the Contract.

2. During the period between the completion of electrical installation and the startup and testing of all other Work, the Contractor shall make all completed and serviceable components of the electrical installation available to the other Contractors for their use in performing Preliminary and Final Field Tests.

3. Before each test commences, the Contractor shall submit a detailed test procedure and also provide manpower and scheduling for the approval of the Engineer.

4. The Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of systems by other Contractors.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 09 13 – ELECTRICAL MONITORING AND COMMUNICATION SYSTEM (EMCS)
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install, test and place into satisfactory operation Electrical Monitoring and Control System (EMCS) as shown on the Contract Drawings and as specified in this Section.

B. The EMCS shall be provided by a qualified EMCS System Supplier.

1. The Contractor shall ultimately be responsible for the EMCS and shall supplement the System Supplier's Work as necessary to provide a complete and operable system.

2. The Contractor shall coordinate the equipment and systems provided by others that interface with the EMCS to ensure necessary interconnections and compatibility are provided for the required functionality of the EMCS.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	50
2.04	Source Quality Control / Shop Tests	50
PART 3	EXECUTION	53
3.01	Examination / Preparation	53
3.02	Implementation	53
3.03	Field Testing / Quality Control	53
3.04	Startup / Demonstration	54
3.05	Adjusting / Protection / Cleanup	54

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 80 82 - PMCS Startup and Field Testing.

1.04 REFERENCES

A. Definitions

1. COMTRADE as used in this Section shall mean Common format for Transient Data Exchange.
2. DHCP as used in this Section shall mean Dynamic Host Configuration Protocol.
3. Electric Utility or Utility as used in this Section shall mean the Local Electric Utility having jurisdiction.
4. The Electric Utilit**y** or Utility is Con Edison.
5. EPSS as used in this Section shall mean Emergency Power Supply System.
6. GPS as used in this Section shall mean Global Positioning Systems
7. IPv4 or IPv6 as used in this Section shall mean Internet Protocol version 4 or 6.
8. IRIG-B as used in this Section shall mean Inter-Range Instrumentation Group time code B.
9. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation at less than 1000 volt and within the 600 V Class.
10. Medium-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation above 1000 volts and below 99,000 volts.
11. NTP as used in this Section shall mean Network Time Protocol.
12. NFC as used in this Section shall mean Near Field Communicator or Near Field Communication.
13. OPC as used in this Section shall mean Open Platform Communication.
14. PMC**S** as used in this Section and the Contract Documents is as defined in Section 40 61 13 – PMCS General Requirements.
15. PQ as used in this Section shall mean Power Quality.
16. PTP as used in this Section shall mean Precision Time Protocol as defined in IEEE 1588

17. RBAC as used in this Section shall mean Role Based Access Control.
18. THD as used in this Section shall mean Total Harmonic Distortion.
19. TPM as used in this Section shall mean Trusted Platform Module.

B. Reference Standards

1.	ANSI C12.20	-	Electricity Meters – 0.1, 0.2 and 0.5 Accuracy Classes.
2.	AES 256	-	Advanced Encryption Standard 256 bits
3.	EN 50160	-	Voltage Characteristics of Electricity Supplied by Public Electricity Networks.
4.	IEC 61000-4-7	-	General Guide on Harmonics and Inter-harmonics for Power Supply Systems and Equipment Connected thereto.
5.	IEC 61000-4-15	-	Flickermeter – Functional and Design Specifications.
6.	IEC 61000-4-30	-	Power Quality Measurement Methods.
7.	IEC 61850	-	Communication Network and Systems for Power Utility Automation.
8.	IEC 62443	-	Industrial Automation and Control Systems Security.
9.	IEC 62586-2	-	Power quality measurement in power supply systems - Part 2: Functional tests and uncertainty requirements.
10.	IEEE 519	-	Requirements for Harmonic Control in Electric Power Systems.
11.	IEEE 802.3	-	Ethernet
12.	IEEE 1588	-	Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.
13.	NYCEC	-	New York City Electrical Code.
14.	SHA-512	-	Secure Hash Algorithm - 512

1.05 DESCRIPTION

A. The EMCS shall provide monitoring, control and communication functions for all elements of the electric power system, such as circuit breakers, motor starters/ controllers, programmable logic controllers, automatic transfer switches, disconnect switches and panelboards.

B. The EMCS connected devices and equipment shall be as shown on per the Contract Documents. See Article 1.03 – Related Sections.

C. The EMCS interface shall be HMIs, Workstations and Large Display Screens complying with Section 40 68 13 – PMCS HMI Software Requirements, Section 40 67 23 – PMCS Operator Consoles and Section 40 62 43 – PMCS Large Display Screens.

D. EMCS displays on interfaces shall be based on the single line diagrams detailed on the Contract Drawings.

E. The goal of the EMCS is to provide hardware, software and equipment to enable the user to seamlessly manage the electric power system.

F. The EMCS includes but not limited to, remote devices for metering, monitoring, control and protection, devices with embedded metering, monitoring and control and protection capabilities in addition to their primary function, network time server, Ethernet communication gateways, intercommunication wiring and ancillary equipment of the electric power system provided under this Contract.

G. Startup and training services shall be provided for all equipment of the EMCS.

1.06 QUALITY ASSURANCE

A. EMCSs shall conform to the requirements in this Section and those detailed in Section 40 61 13 – PMCS General Requirements, where all instances of PMCS shall be replaced by EMCS.

B. The EMCS be the product and supporting services of a single manufacturer provided by one Supplier who shall have the sole responsibility of matching all components and providing equipment which functions together as a system.

C. The EMCS manufacturer shall have been regularly engaged in the manufacture of the specified hardware, software, connected devices and remote devices for a period of at least ten (10) years and demonstrate that these products have been utilized in satisfactory use in functioning systems for similar applications.

D. The manufacturer shall have at least ten (10) years demonstrated capability in EMCS design, installation and start-up.

E. The Contractor shall submit a list of at least 10 existing operating installations each having a minimum of 100 remote devices communicating with the EMCS.

F. The EMCS shall comply with the applicable portions of IEEE 802.3 and NEMA standards.

G. In addition, the master control unit shall comply with FCC Emission Standards specified in Part 15, Subpart J for Class A application.

1.07 SUBMITTALS

A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer.

B. Submittals shall include, but not be limited to the following:

1. Working Drawings:

a. System description including an overview of the system provided with detailed description of system architecture.

b. A customized system diagram showing location of computers, repeaters, gateways and assemblies/devices to be connected to the system, as well as types of wiring required (twisted pair, coax, fiber), and a general layout of wiring referencing the specific building/facility layout shall also be part of this description.

c. Hardware and software description shall be provided in detail for all communications hardware, software, including sensor devices gathering data to be transmitted over the network and to HMIs and display unit. This description will include all the communicating devices to be connected to the network.

d. Equipment specifications and data sheets identifying all materials used and methods of fabrication.

e. Complete assembly, layout, and installation drawings with clearly marked dimensions.

f. Equipment cross section drawings.

g. Weights of all component parts, assembled weight of units and approximate total shipping weight.

h. Interconnection Wiring Diagrams.

i. List of Spare Parts.

j. List of Special Tools.

k. Installation instructions.

l. All communications hardware, software and sensor devices shall be submitted in accordance with the requirements of Section 40 61 13 – PMCS General Requirements.

2. Certificates of Compliance/Manufacture.

   a. Letters stating qualifications of manufacturer.

3. Reports

   a. All shop test and field test reports.

   b. All manufacturer's site visit reports.

4. Operation and Maintenance Manuals

   a. Operation and maintenance manuals shall be submitted in accordance with the Contract Documents.

5. System Supplier's software license requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to the site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements.

C. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation.

D. Protect all electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

E. Deliver material, equipment and software in manufacturer's original unopened protective packaging unless it is built into new distribution equipment.

F. Securely store materials in original packaging in a manner to prevent soiling, physical damage, incursion of moisture or corrosion prior to installation.

G. Handle in a manner to prevent damage to finished surfaces.

H. Maintain protective coverings until installation is complete and remove such covers as part of final clean-up.

I. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

J. Where applicable, EMCS components included with power equipment lineups shall be factory installed, wired and tested prior to shipment to the job site.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Any specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished.

B. At a minimum, the following shall be provided:

1. Provide PC-based configuration software tool and a minimum of one communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.

2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.

3. Spare parts shall be properly marked and packaged for long term storage.

4. Printed circuit boards shall be provided in separate anti-static containers.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. EMCSs shall be as manufactured by:

1. Schneider Electric, Andover, MA.
2. Rockwell Automation, Rochester, NY.
3. GE Grid Solutions, Markham, ON, CA.
4. ABB, New Berlin, WI
5. Or approved equal

B. Revenue Grade Meters shall be as manufactured by:

1. Schneider Electric, Andover, MA.
2. Rockwell Automation, Rochester, NY.
3. GE Grid Solutions, Markham, ON, CA.
4. ABB, New Berlin, WI
5. Or approved equal.

C. Advanced Power Meters shall be as manufactured by:

1. Schneider Electric, Andover, MA.
2. Rockwell Automation, Rochester, NY.
3. GE Grid Solutions, Markham, ON, CA.
4. ABB, New Berlin, WI
5. Or approved equal.

D. Power Meters shall be as manufactured by:

1. Schneider Electric, Andover, MA.
2. Rockwell Automation, Rochester, NY.
3. GE Grid Solutions, Markham, ON, CA.
4. ABB, New Berlin, WI
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. EMCS Feature Overview

1. The EMCS shall provide the following monitoring, control, communication, data and analytics functionality:
    a. Energy performance optimization
    b. Power reliability and availability, and
    c. Sustainability metrics.
    d. Real-time monitoring, alarming and event management, energy, power, and sustainability data analytics and visualization will facilitate the following functions at a high level:
        1) Analyze energy usage and uncover savings opportunities.
        2) Meet and exceed energy efficiency and sustainability standards and certifications.
        3) Measure return on investment of energy capital projects.
        4) Allocate and bill energy costs accurately to processes, areas, cost centers, and buildings.
        5) Decrease the frequency and duration of unplanned outages.
    e. Improve workplace safety by minimizing exposure to electrical hazards.
    f. Provide accurate and automated documentation for regulatory compliance.
    g. Improve the effectiveness of equipment maintenance activities.
    h. Manage multiple power generation sources effectively.
    i. Increase the return on electrical distribution assets.
    j. Measure and achieve sustainability targets.
2. Data and analytics provided by the EMCS for centralized display, analysis, logging, alarming, event recording, and other EMCS operations shall be accessible from a computer workstation with supported operating system and interface software.
3. Proposed screens and report formats shall be reviewed by the Engineer throughout the configuration process.
    a. The System Supplier's programming personnel shall attend an initial review meeting.
    b. A second review meeting shall be held at approximately 50 percent completion.

c. A "Software Configuration Standards and Conventions" document shall be prepared and submitted by the System Supplier after the first EMCS Software Configuration Review Meeting to document decisions made at the meeting.

4. Software License

a. All software programs supplied as a standard part of System Supplier's products for this project shall be licensed to the City for use on the system specified herein.

b. Such license shall not restrict City from using the software on the system provided hereunder or its replacement.

c. City shall have the right to make copies of the software for use on the system provided.

d. Specific requirements of System Supplier's software license shall be submitted to the Engineer for review and approval.

5. Computers / Servers

a. Computers systems including servers, workstations, etc. required for the EMCS shall be as depicted on the Contract Drawings and shall be furnished and installed under this Contract,

B. EMCS Software

1. General:

a. Furnish a dedicated, edge control, software platform (The Software Platform) to be the operational interface for the EMCS to manage safe, reliable and efficient power within buildings and facilities.

b. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:

1) Electrical Distribution System Control, Monitoring and Alarming.

2) Electrical System Capacity Management.

3) Power Quality (PQ) Monitoring and Compliance.

4) Continuous Electrical Thermal Monitoring.

5) Breaker Setting Monitoring.

6) Backup Power Testing.

7) Power Events Analysis.

8) Energy Usage Analysis and Energy Benchmarking.

9) Utility Bill Verification and Cost Allocation.

10) Energy Performance Analysis and Verification.

c. The Software Platform shall natively support (without additional installation or configuration) at least 200 devices specifically designed for power distribution and PQ monitoring including:

1) programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, protective relays, uninterruptible power supplies, active harmonic filters, capacitor bank controllers, and electrical distribution thermal sensors.

2) Native device support shall include:

a) All registers pre-mapped to standard measurement names without requiring additional register mapping.

b) A comprehensive set of factory device graphical screens without requiring additional graphics creation or installation.

c) Fully factory-tested support.

d. The Software Platform shall be designed to comply with cybersecurity standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SL1).

e. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire.

2. Real Time Monitoring:

a. The Software Platform shall support the creation of diagrams representing the Power System, including electrical one-line diagrams, facility maps, plan views, floor layouts, equipment representations, and mimic displays.

b. The EMCS shall have a graphic library with standard electrical one-line symbols to simplify the creation of single line diagrams.

c. The Software Platform shall have the capability to graphically trend in real-time any measurements supported by metered connected electrical equipment.

d. The Software Platform shall allow users to easily create interactive side-by-side visualizations of any real-time measurements to:

1) Display tabular & trend line views to compare readings from multiple devices.

2) Create, modify, view and share table views directly, without additional software.

3) Support both physical and virtual devices defined in the system.

4) Support exporting real time data into Excel formats, without additional software.

e. The Software Platform shall support the Automatic Network Diagram Creation feature, whereby a comprehensive set of linked hierarchical graphical diagrams can be automatically created for any supported connected device.

f. The Software Platform shall support Advanced Power Meters with onboard high speed Power Analysis and Disturbance Direction Detection (DDD) capabilities, and include a set of real-time graphical indicators for use in electrical diagrams indicating

1) the type of Power Quality Disturbance (sag, swell, transient).

2) the direction of PQ Disturbance relative to the reporting DDD device (upstream, downstream).

g. The Software Platform shall provide real-time indication of aggregated demand measured by one or more devices in a predefined zone, with the following capabilities.

1) Zone demand expressed using either Kilowatts or normalized Kilowatts/Area.

2) Visual indication of how present zone demand compares with four (4) configurable limits / targets using a color scale.

3) Configurable limits to allow different values during On-Peak & Off-Peak periods.

3. Alarm and Event Analysis & Notification:

a. The Software Platform shall support acquiring specialized, high speed power disturbance data directly from Advanced Power Meters for Power Events Analysis, including:

1) Timestamped Power Events with Disturbance Direction Detection (DDD).

2) Timestamped high speed (1/2 cycle sample rate) pre/post event RMS data.

3) Pre/post event waveform captures (Voltage and Current all phases).

b. The Software Platform shall include an alarm annunciator displaying the total number of unacknowledged alarms with

categorization into high, medium and low priority, and easy navigation to the alarm viewer.

c. The Software Platform shall support analysis of cascading power events with the following capabilities.

1) Automatic, intelligent clustering of events into grouped alarms, and multiple alarms from multiple devices into “incidents”.

2) Automatic categorization of alarms and incidents into predefined categories such as Power Quality, Power Availability, Diagnostics and Other.

3) Predefined views for events, alarms and incidents with intuitive navigation and configurable filters based on priority, status, source and categories.

4) Ability to create private or shared views with custom filters.

5) Ability to drill into details about location, time and nature of the alarm or incident, with associated information including Power Disturbance and Power Quality data.

6) Clear graphical indication of the direction (arrow) of a Power Disturbance for alarms and incidents captured by Disturbance Direction Detection (DDD) compliant devices.

d. The Software Platform shall provide a graphical timeline view of alarms and events constituting an “incident” in the electrical distribution network, with the capability to

1) Display alarms/events stacked by order of time for sequence of events analysis.

2) Display the start and end of alarms/events.

3) Indicate the direction of the incident with any associated, captured waveforms.

4) Display pre- and post-event high speed RMS data from supported meters.

4. Data Analytics and Visualization:

a. The Software Platform shall include an interactive, web-based Dashboard application supporting electric, historical data trends, power quality, images, and external content from any accessible URL address.

b. Users shall be able to create, modify, view, and share dashboards including graphics, labels, scaling, measurements, date ranges, etc., without additional software.

c. The Software Platform shall support kiosk slideshow displays to run in unattended mode, scrolling through designated dashboards at a configurable time interval.

1) Any number of kiosk slideshow displays may be created and configured to run independently on any computer using a browser.

d. The Dashboard application shall provide a library of standard graphical objects (gadgets) including Bar, Pie, Trend, Real Time and Web Portal

e. The Dashboard application shall provide a library of specialized energy usage graphical objects (gadgets) including Period Over Period Comparison, Pareto Charts, Heat Map / Carpet Plot and Sankey Diagrams

f. The Dashboard application shall provide a library of specialized Power Quality graphical objects (gadgets) including PQ Downtime Impact, PQ Rating, PQ Incident Breakdown and Location.

g. The Software Platform shall provide an interactive, web-enabled Reports application, allowing users to generate, modify, save and manage reports based on pre-engineered report templates for:

1) Energy Billing, Verification and Allocation.

2) Energy Management and Performance.

3) Power Quality Performance and Compliance (IEEE 519).

4) Electrical Equipment Operation and Performance.

h. The reporting tool shall support automatic distribution (via email or shared folder) on a scheduled basis or based on event or manual export using the following output formats: .csv, .xlsx, .pdf, .tiff, .html, .xml.

5. Technical Requirements:

a. The Software Platform shall support installation on a physical computer or virtual machine and shall support a variety of Windows operating systems including Server and non-Server class Windows operating systems.

b. The Software Platform shall support a variety of SQL Server Editions including Enterprise, Standard and Express Editions.

c. The Software Platform shall only require SQL Server Database Engine Services and Basic Management Tools, and not require additional SQL components such as Analysis Services or Reporting Services.

d. The Software Platform shall support the following cybersecurity features:

1) Encrypted transmission of data between the Software Platform Server and its Web Clients using Transport Layer Security (TLS) version 1.2.

2) Secure authentication between the Software Platform Server and its Web Clients using Certification Authority (CA) certificates.

3) Encryption & hashing of system credentials using AES-256 & SHA-512 respectively.

4) Installation in a Federal Information Processing Standard (FIPS) compliant environment.

e. The Software Platform shall support the integration of Windows Active Directory for users and groups across multiple domains to facilitate the following:

1) Login using Windows credentials.

2) Enforce password policies via Windows (complexity and expiration).

3) RBAC.

f. The Software Platform shall automatically acquire on-board data (including events, trends and waveforms) from natively-supported device types without additional software configuration or data upload scheduling.

1) Onboard, high resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP.

g. The Software Platform shall support logical device definitions based on inputs/outputs or channels on devices representing downstream circuits, with the following features:

1) User interface for device and measurement mapping.

2) Bulk-import capability to create large numbers of logical devices without manual single-device configuration

h. The Software Platform shall support real-time and historical data aggregation within defined hierarchy views (e.g. Switchgear, MCC, PDUs//Panels, Buildings/Floors/Rooms, or any user defined view) with the following capabilities:

1) Web-based, end user interface.

2) Automatic, intelligent data aggregation across all nodes in the hierarchy for data visualization in dashboards, trends and reports.

3) Creation of virtual devices to enable net metering, common area allocation and apportionment.

4) Update node names and associated time ranges in the hierarchy to accurately represent & report on facility changes..

5) Bulk-import capability to create and edit large hierarchies without manual per-device setup.

i. The Software Platform shall support device-level Modbus integration with the following capabilities:

1) Modbus master to read/write registers in Modbus devices for monitoring and control applications.

2) User interface to create and manage Modbus device definitions (device drivers) and association of device graphic template screens.

j. The Software Platform shall support OPC DA Server 2.01 with the following capabilities:

1) Provide default OPC Server tag mappings for all natively supported device types without the need for manual mapping of device registers to OPC tags.

2) Add or change OPC mappings, or add custom measurements.

k. The Software Platform shall support OPC DA Client 2.01 with the following capabilities:

1) User Interface to create and manage OPC device definitions (device drivers) and association of device graphic template screens.

2) Built in OPC Test Client.

l. The Software Platform shall support Web Services interoperability with the following capabilities:

1) Web Services Server to share real-time, historical (i.e. timestamped trend data), and alarm data (i.e. timestamped event strings) to other Web Services Client applications.

2) User interface for Web Services configuration and mapping.

3) Ability to acknowledge alarms by authenticated and authorized clients.

m. The Software Platform shall have an Extract, Transform, and Load (ETL) engine to exchange data between files, databases and systems with the following capabilities:

1) User Interface to specify connection information, data formats, measurement mappings and schedules.

2) Support for importing data from .csv and .xml data files, Wonderware Historian databases and other 3rd party databases via OleDB connections.

n. The Software Platform shall support system-wide programming extensibility, using a graphical, object-oriented application engine capable of logic & arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, email & text notifications.

o. The Software Platform shall remain online during all system administration functions (including communications, logging, and alarming) and not require an operator to take the system offline.

p. The Software Platform default language shall be English.

q. The Software Platform shall support offline software configuration management for efficient system deployments and upgrades with a dedicated user interface for creating, copying and deploying software configuration projects.

C. Communication and Interfaces

1. The EMCS system shall communicate with equipment, devices, servers, etc. through an EMCS network.

The EMCS network shall primarily use Ethernet except where specifically specified or shown on the Contract Drawings.

2. The EMCS network shall include but not be limited to the following:

a. Connections to and use of the Plant’s existing Ethernet network.

b. Ethernet network as shown as shown on the Contract Drawings.

c. Serial communication connections where specified or shown to gateway devices for Ethernet EMCS network interface.

d. Connection to the Building Management System network.

e. Connection to the PMCS or SCADA system network.

3. Cyber Security

a. The EMCS shall follow best practices for cyber security and provide technical features to reduce risk to people, assets and processes.

b. Implement secure network architecture.

c. Use 2 Factor Authentication.

d. User privilege / authentication policy.

e. Align with ISA/IEC-62443 series of standards and practices.

f. Align with DEP OIT cyber security requirements and practices.

4. Unless specified or shown otherwise, the EMCS shall communicate to equipment using Modbus TCP Ethernet protocol.

a. Modbus serial protocol shall only be used where specifically specified or shown.

b. The EMCS Supplier on behalf of the Contractor shall coordinate between all manufacturers to ensure compatibility between software, computer systems, network, communications gateways, connected equipment, etc. for the specified functionality of the EMCS.

c. The manufacturer of equipment to be connected to the EMCS shall provide the necessary compatible interface to the EMCS system's network and software.

d. Any required gateways, transceivers, converters, etc. for this interface shall be integral to the supplied equipment.

D. Connected Equipment

1. Connected Equipment shall contain one or more Connected Devices (e.g. meters, circuit breakers, gateways, sensors, etc.).

2. Connected equipment shall include an internal inter-wired communications network for a singular connection to the EMCS network for power monitoring, control, equipment status and alarms.

3. Connected Equipment (e.g. switchgear, motor control centers, motor controllers, switchboards, panelboards, automatic transfer switches, multi-meter enclosures, etc.) shall be integrated with the EMCS network and system as required to support the specified EMCS applications.

4. Additional Connected Equipment shall be integrated with the EMCS as shown on drawings or as specified within the device's specification.

E. Connected Devices

1. Devices shall be connected to the EMCS network for power monitoring, equipment status, alarms, etc. and to provide the required functionality of the EMCS.

2. Connected Devices shall be integrated with the EMCS network and system as required to support the specified EMCS applications.

3. Additional Connected Devices shall be integrated with the EMCS as shown on Contract Drawings or as specified within the device's specification.

F. Connected Devices - Meters

1. Revenue Grade Meters

a. Revenue Grade metering devices shall be used to monitor incoming Utility Low and Medium-voltage services for grid revenue, substation automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting

b. Revenue Grade Meter shall have at minimum the following features:

1) Voltage and Current

a) 3 phase, 120 VAC circuits derived from revenue grade voltage and potential transformers

b) 5 A nominal current circuits derived from revenue grade current transformers.

2) Measured and calculated metering parameters shall include four-quadrant metering, full range of three-phase voltage, current, power and energy measurements, percentage unbalance, true and displacement power factor per phase and three phase, demand (minimum/maximum, present demand interval, running average demand, and predicted demand, THD, individual current, and voltage harmonics readings.

3) Less than half the measurement error of ANSI C12.20 class 0.2 accuracy over the Class 2/10/20 current classes.

4) Support up to 8 points of magnitude and phase correction for each voltage and current measurement input.

5) Capable of meeting all accuracy specifications after withstanding 500A for 1 second or 2500 VAC RMS for 1 minute, with internal protection disabled.

c. Revenue Grade Meter shall have a high-visibility display with the following characteristics:

1) User programmable to display up to 4 parameters per screen.

2) Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.

3) Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.

d. Revenue Grade Meter shall have the following Input/outputs:

1) Provide at least the following inputs and output for equipment status/position monitoring and equipment control or interfacing:

2) 4 digital inputs

3) 4 digital output

4) 4 analog 4-20 mA inputs.

e. Revenue Grade meter have/support the following communications capability:

1) Ethernet, RS485/232 serial, ANSI 12.18 compliant optical port.

2) Support for DNP3.0 (Ethernet/serial), Modbus slave/mastering (Ethernet/serial); SMTP/SNTP(Ethernet); MV90(Ethernet/serial); XML(TCP); IEC61850(TCP).

3) IRIG-B port to allow GPS time synchronization to +/-1ms accuracy from GPS source.

f. On-board logging.

1) Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.

2) Ability to record any parameter in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).

3) Continuous recording of intervals from 100 years down to ½ cycle.

4) Number of records (depth) and overflow conditions (stop-when-full or circular) shall be programmable.

g. On-board web server that can be used for:

1) Access to real-time values and basic power quality data through a web browser.

2) Basic meter configuration.

h. Alarming capabilities:

1) Set-point driven alarming capability.

2) Generate notification upon an alarm condition.

3) Millisecond resolution timestamp on alarm entries

4) Support consecutive high-speed alarm conditions for alarms and waveform recording, triggering on a cycle-by-cycle basis with no “dead” time between events (i.e., no need for a re-arming delay time between events).

5) Operate relays or initiate data logging captures on alarm conditions.

6) Control any number of digital output relays in an AND or an OR configuration using pulse mode or latch mode operation for control and alarm purposes.

7) Combine any logical combination of any number of available set-point conditions to control an internal or external function or event.

i. Time-stamped event log (1 ms resolution) with the following characteristics:

1) Support at least 500 events, programmable up to a maximum of 20000 events.

2) For each event, record date and time, cause and effect, and priority.

3) Record all events relating to set-point activity, relay operation, and self-diagnostics.

4) Capable of synchronizing time stamps between devices on the same serial communications network, to within 1 ms.

5) Minimum event recording response time is ½ cycle for high-speed events and 1 second for other events.

6) Programmable set-point events.

j. Power quality analysis and compliance monitoring.

1) Without separate software, shall have the following capabilities:

a) Display statistical indicators of power quality on the front display.

b) Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point.

c) When set-point is exceeded, enable control via a local interface to PQ mitigation equipment or control systems through relays and analog or digital outputs.

(1) Third party Laboratory tested to the power quality standards IEC 61000-4-30 Class 'A' 2nd edition and IEC 61000-4-15.

(2) Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7

k. Fault recording and waveform capture.

1) Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.

2) 1024 samples per cycle waveform recording, minimum 17 μs transient capture (60 Hz).

3) Configurable to provide COMTRADE waveforms for all captures.

l. Disturbance detection.

1) High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.

2) Detect disturbances less than one cycle in duration.

3) Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter.

4) Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.

m. Programmability.

1) Capable of deriving values for any combination of measured or calculated parameter using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions,

2) Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.

3) Capable of integrating with custom reporting, spreadsheet, database and other applications with XML compatible data.

2. Advanced Power Meters

a. Advanced Power Meters shall used to monitor medium and Low-voltage services, critical feeders and generators for generator test documentation, EPSS Test Automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting

b. Advanced Power Meters shall have, at minimum, the following features:

1) Voltage and Current

a) 3 phase, 120 VAC circuits derived from metering voltage and potential transformers

b) 5 A nominal current circuits derived from metering current transformers.

2) Measured and calculated metering parameters shall include four-quadrant metering, full range of three-phase voltage, current, power and energy measurements, percentage unbalance, true and displacement power factor per phase and three phase, demand (minimum/maximum, present demand interval, running average demand, and predicted demand), THD, individual current, and voltage harmonics readings.

3) Meet stringent ANSI measurement accuracy standards including ANSI C12.20 accuracy class 0.1, current class 2, 10 and 20.

c. Advanced Power Meters shall have a high-visibility color graphical display with the following characteristics:

1) User programmable to display up to 20 parameters per screen.

2) Capable of displaying graphical metering data including at minimum spectral components, phasor diagrams, and trending charts.

3) Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.

4) Provided with a 7.0” graphical color display with touchscreen control.

d. Advanced Power Meters shall have the following Inputs/Outputs:

1) Provide at least the following inputs and output for equipment status/position monitoring and equipment control or interfacing:

a) 8 digital inputs

b) 2 digital output

c) 2 relay output

d) 4 analog 4-20 mA inputs.

e) The digital (pulse) output operation shall provide kWh / kVARh total/imported/exported energy consumption.

f) The meter shall accept up to four field installable I/O modules.

g) Each digital I/O module shall provide 6 digital status/counter inputs and 2 Form C relay outputs rated at 250 V, 8 A.

h) Each analog I/O module shall provide 4 inputs configurable to 4-20 mA or 0-30V ranges and 2 outputs configurable to 4-20 mA or 0-10V ranges.

e. Advanced Power Meters shall have/support the following communications capability:

1) At least 2 Ethernet ports and 2 RS485 serial ports.

2) The Ethernet ports shall support IPv4 and IPv6 with DHCP IP address assignment.

3) The meter shall provide an Ethernet-to-serial RS-485 gateway function.

4) Support for Modbus, DNP3.0, and IEC 61850.

5) Provide enhanced cybersecurity features that include but are not limited to HTTPS in accordance with TLS 1.2.

6) Comply with cybersecurity directives, with the meter the ability to independently enable or disable communication ports, enable or disable communication protocols per communications port, and assign TCP/IP port numbers per communications protocol.

7) Provide a Security log to capture security related events such as log-in / log-out (whether successful or failed), configuration changes, resets, and other events identifying the date and time of the event and the user name of the requestor.

8) The meter shall support Syslog protocol to deliver security events to a network management server.

9) The meter design shall include a Trusted Platform Module (TPM).

10) Capable of self-identification on an Ethernet network without any device configuration or user interaction.

f. On-board logging

1) Non-volatile time stamps with on-board logging of I/O conditions, min/max values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.

2) Ability to record any parameter in the meter, and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity in which the meter has the capability of learning set-point limits based on the system behavior).

3) The meter shall support user defined recording intervals down to ½ cycle.

4) Number of records (depth), and overflow conditions (stop-when-full or circular) shall be user programmable and limited only by available memory.

g. On-board web server shall provide:

1) Access to real-time values, power quality information, and basic meter configuration.

2) Waveform viewing capability with the ability to visualize all voltage and current phases of captured waveforms concurrently using a standard web browser, allows waveform selection, voltage and current phase selection, zooming in and out, panning with select zoom, saving and printing.

3) Fully customizable web interface with support for user defined web views.

h. Alarming capabilities:

1) Provide set-point driven alarming capability.

2) Generate an notification on an alarm condition.

3) Shall have millisecond resolution timestamps on alarm entries.

4) Support consecutive for high-speed triggers for alarms and waveform recording, triggering on a cycle-by-cycle basis

with no "dead" time between events (i.e. no need for a re-arming delay time between events).

5) Operate relays or initiate data logging captures on alarm conditions.

6) Control any number of digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.

7) Combine any logical combination of available set-point conditions to control an internal or external function/event.

i. Provide a time-stamped event log (1 ms resolution) with the following characteristics:

1) Support for at least 500 events, programmable up to a maximum of 20000 events.

2) For each event record date and time, cause and effect, and priority.

3) Record all events relating to set-point activity, relay operation, configuration, and self-diagnostics.

4) The event recording response time shall be ½ cycle (8.3ms 60Hz) for high-speed events and 1 second for other events.

5) Capable of receiving time synchronization signals to ensure that the time stamps between devices on the same communications network are within +/- 1 ms;

6) Precision time synchronization methods shall include GPS clock via RS485 serial port, IRIG-B (unmodulated) via digital input, and Precision Time Protocol (PTP) via Ethernet.

j. Power quality analysis and compliance monitoring

1) The meter shall provide the following capabilities without separate software:

a) Display statistical indicators of power quality on the front display.

b) Provide statistical indicators of power quality that include, but are not limited to, voltage dips and swells, harmonics, frequency, rapid voltage change and mains signaling in accordance with EN 50160:2010 (Edition 4) power quality standard and provide an indication of pass / fail in a web interface.

c) Concurrently with the EN50160 power quality analysis, the meter shall provide statistical indicators of power quality that include, but are not limited to, total harmonic distortion for voltage and current, total demand distortion for voltage and current in accordance with IEEE519 power quality standard and provide an indication of pass / fail in a web interface.

d) Compare power quality parameters (present, average or calculated values) with an absolute or relative setpoint, and alert, or enable control (via a local interface to PQ mitigation equipment/control systems through relays and analog or digital outputs) when set-point is exceeded.

e) The meter shall be certified by a third party laboratory to the power quality standards IEC 61000-4-30, Edition 3 Class 'A' and IEC 61000-4-15 (Flicker) according to IEC 62586-2, Edition 2.

f) Low-pass anti-aliasing signal filters shall meet the requirements of IEC 61000-4-7.

k. Fault recording and waveform capture

1) Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.

2) Rate shall be 1024 samples per cycle waveform recording, with minimum 17/20 microsecond transient capture (60/50 Hz).

3) The meter shall provide the ability to record sixty (60) cycles with thirty (30) cycles prior to the fault at 1024 samples per cycle minimum.

4) Configurable to provide up to 225 COMTRADE disturbance capture files for waveforms that are available via FTP and provide client notification of new captures through IEC 61850 (RDRE logical node).

5) Record over a minute of 1-cycle RMS values every ½-cycle for voltage, current, frequency, power, power factor and unbalance, based on a power system event, and record 30-seconds of 1-cycle RMS values prior to the event trigger.

l. Disturbance detection

1) Provide high-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.

2) Detect disturbances less than one cycle in duration.

3) Determine the location of a disturbance more quickly and accurately by identifying the direction of the disturbance relative to the meter.

4) Capture analysis results event log, along with a timestamp and confidence level indicating level of certainty.

m. Programmability

1) Provide a graphical flexible programming capability with programmable modules that access metered and input data.

2) Capable of deriving values and combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization and temperature conversion functions.

3) Have programming modules that can be arbitrarily linked together to create application functionality such as totalizations, efficiency measurements, load aggregation, control functions, load shedding, demand response, power factor correction, and compliance monitoring.

4) Ability to read data from networked Modbus devices for the purposes of logging, exporting, aggregation, totalization, display visualization, web visualization or other user defined functions.

3. Power Meters

a. Power Meters shall be provided to monitor medium and Low-voltage feeders, transfer switches, for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting

b. Power Meters shall have at a minimum the following features:

1) Voltage and Current

a) 3 phase, 120 VAC circuits derived from metering revenue grade voltage and potential transformers

b) 5 A nominal current circuits derived from revenue grade current transformers.

2) Power Meters shall have a high-visibility color graphical display.

3) Full range of 3-phase voltage, current, power, and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream or downstream).

4) Up to 255 COMTRADE disturbance capture files available directly from meter via FTP and providing client notification of new captures through IEC 61850 (RDRE logical node).

5) Without using separate software, determine statistical indicators of power quality that include but are not limited to voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface; Third party laboratory tested to the power quality standard IEC 61000-4-30 Class 'S'.

6) Capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules.

7) Link modules in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.

8) Multi-port Ethernet and serial communications with at least two Ethernet ports and one RS485 serial port.

9) Functionality through Ethernet connectivity includes SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.

10) Time stamped on-board logging of input/output (I/O) conditions, minimum and maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping in which the meter has the capability of learning set-point limits based on the system behavior; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.

11) Provide at least three 3 digital inputs and 1 digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp.

12) Accept up to four field installable I/O modules.

13) Provide additional modules as required for application.

14) Each digital I/O module shall provide 6 digital status/counter inputs and 2 Form C relay outputs rated at 250 V, 8 A.

15) Each analog I/O module shall provide 4 inputs configurable to 4-20 mA or 0-30V ranges and 2 outputs configurable to 4-20 mA or 0-10V ranges.

16) Provide an indication of the location of each power system event as “upstream” or “downstream” along with the level of confidence of the location.

G. Monitoring and Alarming

1. The EMCS in conjunction with connected devices shall provide screens displaying real-time data from the electrical infrastructure, such as incoming Utility feeds, medium voltage, and low voltage distribution equipment.

2. Relevant real-time data from energy meters and other facility metadata, such as water, air, gas, electric, industrial process data, weather, occupancy, etc. shall be displayed from the connected devices, equipment and systems compatible with the EMCS.

3. Real-time data shall also be organized and displayed along with other analytics functions of the EMCS software to provide logical views for the health of the system and to support EMCS applications specified herein.

4. The EMCS shall provide a set of screens showing the complete electrical single line diagrams for the facility and the following minimum functionality shall be provided:

   a. Links to navigate between various levels of the single line diagram.

   b. Electrical parameters for all equipment detailed on the single line (such as switchgear, transformers, generators, unit substations, switchboards, UPSs, isolated panel systems).

   c. Link to power equipment details screens.

5. The EMCS shall include a set of screens showing equipment details including:

   a. Details pertaining to each piece of equipment including local single line, information for each electrical section (for example, breaker and disconnect switch), and all alarm points.

b. Measured demand and loading of equipment (e.g. breakers, UPSs, transformers, generators)

c. A link to each of the default diagrams of each meter/protection device that apply to the piece of equipment.

d. The EMCS shall include a set of screens showing floor plans overlaid with the relevant equipment and relevant real-time data of the respective equipment.

6. The EMCS shall include a summary status screen for alarm indication for major power equipment components of the electrical distribution system.

7. All alarm conditions, events and group related incidents shall be prioritized, organized logically using good alarm management practices for quick and easily situational awareness and actionable intelligence.

8. The EMCS shall also notify appropriate staff members of alarms through designated printers, and screen popup.

H. EMCS Power Quality

1. The EMCS in conjunction with connected embedded power quality(PQ) aware devices shall monitor electrical disturbances such as harmonics, unbalance, flicker, over/under voltage conditions, etc. to assist in the reporting, analysis of conditions and diagnoses of events.

2. The EMCS software shall provide power quality specific screens and reports including but not limited to the following:

a. Device Level Power quality summary screen—the data collected by any compliant PQ-capable metering device shall be summarized to show:

1) Voltage disturbances, including the date and time of the last disturbance, the count of the number of transient events, and the count of the number of sag/swell events.

2) Harmonic measurements, including a link to the harmonics log for the particular device.

3) Total Harmonic Distortion (THD) content and the maximum THD.

4) Flicker measurements.

5) Logged events, including a link to the event log for the particular device.

6) Waveform logs, including a link for waveforms captured during transients and sag/swell events.

7) Detailed waveform analysis tools.

b. The PQ report shall display all power quality events collected in the EMCS for one or more metered points within a given time period.

1) The report shall show a summary table of all the events within a given time period and provide the means to see further details (power quality details report) for any given event.

c. The summary report shall contain a plot of the Information Technology Industry Council (ITI) (also known as ITIC or CBEMA) curve that displays the worst disturbance from each event listed in the summary table.

1) The summary table shall contain the following components for each event:

a) Event identifier.

b) Source.

c) Event timestamp.

d) Phase identifier for the worst disturbance during this event (ex., "V1").

e) Voltage magnitude for the worst disturbance during this event in % of nominal (for example, "68.80%")

f) Voltage magnitude maximum and minimum on all phases and neutral for the worst disturbance during this event in % of nominal.

g) Duration for the worst disturbance during this event in seconds.

h) Disturbance type for the worst disturbance during this event (for example, "sag").

i) ITI (ITIC, CBEMA) tolerance curve violations (for example, "outside tolerance").

j) Link to the details report for this event.

k) Link to waveform report for the worst disturbance during this event.

2) Each entry in the summary table shall include a link that provides further details for the given event. The details to be shown are:

a) Disturbance event timestamp.

b) Phase identifier.

c) Voltage magnitude in % of nominal (for example, "68.80%")

d) Voltage magnitude maximum and minimum on phase V1, V2 and V3 in percentage of nominal.

e) Duration in seconds.

f) Disturbance type.

g) ITI (CBEMA) tolerance curve violations (for example, "outside tolerance").

h) Link to waveform report.

3) Each entry in the summary table shall include a link that shows the waveforms of the given event (if any exist).

a) The waveforms shown shall be for both the voltage and current readings of the measuring point.

3. The EMCS software shall provide for IEEE 519 PQ Compliance Reports as follows:

a. Provide a mechanism to report on IEEE519 limits.

b. Provide a mechanism to report on user defined limits.

c. Ability to determine voltage and Isc/I-l ratio directly from the device at the point of common coupling.

d. For both individual and total harmonic voltage distortion, display the following:

1) The allowable IEEE519 limits.

2) The % time out of compliance.

3) The number of non-compliant three-second intervals.

4) The number of total measured intervals.

5) Number of missing or invalid intervals.

6) Compliance levels of Warning, Out of compliance, or Compliant.

7) A maximum value with a time-stamp of when that distortion was measured.

e. For both individual and total harmonic distortion for current, display all the values specified above for every range of harmonic orders.

f. For each phase, voltage, and current provide a graphical plot of THD versus time stamp.

1) On the same plot, plot the allowable limit to allow for visual comparison of compliance.

g. Provide a graphical plot of “average value of voltage per harmonic” and “average value of current per harmonic” as a percentage of fundamental frequency, versus harmonic order to allow for visual identification of the worst harmonic problems.

h. For each phase voltage and current, provide a graphical plot of harmonic content versus time stamp with simultaneous plot lines for a set of harmonic orders (for example, h <= 11) allowing the user to identify the harmonic orders associated with the worst problems to enable mitigation measures such as active filtering.

4. The EMCS software shall provide power quality analytics functionality, delivered through dashboards and reports.

a. PQ Analytics Key Performance Indicators (KPIs)

1) Tabulate downtime impact by displaying current count (and trend over time), of PQ events (both grid and within-facility), electrical system downtime (in hours) from these events with associated cost.

2) Calculate power factor trends by displaying current value (and trend over time), for average power factor and estimated penalties or surcharges incurred

3) Calculate PQ Indices by displaying an overall health indicator (and trend over time) representing a baseline for the overall PQ of the facility, based on analysis of PQ events and limits and/or thresholds defined by established PQ standards.

a) This index shall be calculated over various time periods, and be represented on a scale of “A” to “F”, with “A” representing optimal, and “F” representing poor.

4) Categorize events by displaying event type (sags, swells, etc.), likely origin (external/within facility) and potential impact to operations per thresholds recommended by recognized PQ standards. Display shall support flexible time periods and trending over time periods.

b. PQ Disturbance Indicator Analytics:

1) The EMCS shall calculate and display a summary screen with high-level health indicators (red, yellow, green) for each type of PQ event/disturbance, based on appropriate industry best practices or standards.

2) Evaluated PQ events/disturbances are:

a) PQ Events are voltage sags/dips, voltage swells, voltage transients, voltage interruptions, over/under voltages

b) PQ Disturbances and other phenomena are harmonic distortion, voltage/current unbalance, frequency variation, flicker

3) The EMCS shall provide aggregate count or maximum/average values (depending on event/disturbance type).

4) The EMCS shall provide the capability to drill down into each PQ event/disturbance type to view the following data (as relevant to the particular event type):

a) source of event (device)

b) timestamp

c) potential impact

d) duration

5) and magnitude.

5. Integration with Power Quality Mitigation Equipment

a. The system shall natively support interfaces with compatible power quality mitigation equipment for power factor correction, harmonic filtering, voltage sag mitigation (UPS), and transient protection to provide end-to-end solutions for monitoring, correction and optimization of power quality. This shall include the capabilities to

1) Monitor key electrical and operational parameters (real-time data & alarm status)

2) Identify operational anomalies easily through color-coded indicators (red, yellow, green)

I. Power Events Recording and Analysis

1. The EMCS shall provide event aggregation and analysis tools to gather time-stamped events from connected devices to provide a consolidated system event view, showing a date/time ordered list of events, event priority and the name of the reporting device.

2. The EMCS shall automatically acquire on-board event data and associated waveforms from compatible connected power quality monitoring devices without additional software configuration or data upload scheduling.

3. The EMCS shall automatically retrieve onboard, high resolution timestamps without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP.

4. Accuracy and Resolution

   a. System-wide events associated with critical status points shall be time-stamped to an accuracy of one millisecond (1 ms.). The following implementation details shall be specified in the "Software Configuration Standards and Conventions" document.

   b. All points shall support the 1 ms. requirement and shall include but not be limited to the following;

      1) All Medium and Low-voltage switchgear and switch boards including multifunction electronic relays, power quality meters, and breaker open/closed/tripped position sensors.

      2) All Medium and Low-voltage equipment such as UPSs, VFDs, distribution panels and PDUs including metering and breaker open/closed/tripped position.

   c. Time synchronization shall be by external GPS time signal or PTP over Ethernet within 100 microseconds.

5. Sequence of Events Recording (SER) Hardware.

   a. SER recording hardware needed to implement the 1 ms. requirement shall comprise an integrated collection of devices and components to provide synchronized time-stamp signals, and record events with an accuracy of one millisecond.

   b. The devices chosen shall be compatible and natively supported by the EMCS software.

   c. The hardware shall include all necessary components to record the most critical system events as defined in the "critical status point list", such as

      1) PTP master clock.

      2) GPS antenna, cable and lightning arrestor.

      3) Clock signal distribution hardware and cabling (for legacy protocols).

      4) Event recorders.

      5) Power quality meters.

      6) Multifunction electronic relays.

      7) Data network components.

      8) Enclosures.

9) Computer equipment.

d. Time stamping and event recording shall be implemented at the field device level where the event occurs rather than at the EMCS server.

1) For instance, a breaker trip event shall be time-stamped by I/O at the local meter or at an event recorder point local to the switchboard location.

2) The use of software to scan, poll, and time-stamp events through a PLC or on a server is not permissible, because this introduces scan time and network communication delays.

e. Hardware requirements for any dedicated sequence-of-events recorders (for 1-millisecond event recording of discrete inputs, such as breaker open/close and trip status) shall include the following key features:

1) Onboard clocks time-synchronized to 1 ms. accuracy.

2) Precision time synchronization input per PTP, IRIG-B, and other time synchronization standards.

3) Thirty-two (32) high-speed digital inputs each with configurable filter, debounce, and chatter functions

4) Onboard data logs for storing events

5) Event log capacity to store 8000 events accessible from multiple masters.

6) Each event record shall contain descriptive information for root-cause analysis, such as time/date stamp, input number, event type, input status, time quality, and unique sequence number.

7) The discrete output from the SER may be used to trigger waveform capture in a power quality meter. This output shall be wired to the designated power quality meter(s) and shall be prewired within connected equipment by the manufacturer.

8) Modbus RTU or Modbus/TCP interface.

9) GPS time synchronization input per the IRIG-B time synchronization standard.

10) Event log capacity to store 8000 events accessible from designate HMIs on the EMCS system.

11) Each event record shall contain descriptive information for root-cause analysis, such as time/date stamp, input number,

event type, input status, time quality, and unique sequence number.

12) Ethernet network interface supporting Modbus TCP/IP and embedded web server for setup and monitoring.

13) Capability to customize embedded web pages.

14) Non-volatile memory to store setup and event data.

15) A built-in, standard SD flash memory card to store user setup values and other user files.

16) Ability to export event data in .CSV format directly from the device without the need for additional software.

17) Ability to serve as a "time distribution hub" for other devices, accepting PTP precision time sync IN (over Ethernet) and outputting the required "legacy" protocol such as IRIG-B, ASCII/RS-485, etc.

f. For multifunction electronic relays with time synchronization capabilities, ANSI function codes of events with one millisecond time stamp shall be accessible for software integration, using a Modbus RTU or Modbus/TCP interface.

g. For power quality meters having time synchronization and waveform capability, the time stamps (one millisecond accuracy) of the waveform shall match the events that initiated the waveform capture.

J. Power Restoration

1. The EMCS in conjunction with connected intelligent circuit breakers shall provide diagnosis of power loss events and assist in the efficient restoration of power.

2. The following shall be provided at a minimum:

a. EMCS and circuit breaker annunciation in case of a circuit breaker trip, opening or loss of power.

3. Collection of event data either across the EMCS or with the use of NFC device if power is lost at the device.

4. Access to event data prior to tripping, root cause explanation and power recovery information including:

a. Health status, protection settings, trip cause, trip history, load measurements and waveform capture of a trip event.

b. Potential trip cause(s) and suggestions for additional investigations needed to determine if power can be restored.

c. Step-by-step circuit breaker reclosing recommendations and power restoration information.

K. Backup Power Testing

1. The EMCS in conjunction with compatible connected power monitoring devices shall provide an EPSS Test Automation mechanism to document backup generator system testing for a written record of generator system inspection, performance, testing, and repairs.

2. Mechanisms of EMCS integration with the generator system, report formats and dashboard layouts shall be specified in “Software Configuration Standards and Conventions" document. The following functionality shall be provided at a minimum.

   a. Fully configured Generator Test and Generator Activity report(s) that can be scheduled per a user-defined interval.

3. The EMCS shall include screens relating to generator system testing displaying the following information:

   a. General Information, Generator name, Nameplate ratings, and Description.

   b. Testing Evaluation Data, Test Load and Test Duration.

   c. Generator Status, Starting, Running, Stopped.

   d. Engine Data, Oil Pressure, Coolant Temperature, and other user defined measurements.

   e. Exhaust Gas Data, Exhaust Gas Temperature (left/right manifolds).

   f. Electrical Data, Voltage, Current, Power (Active, Reactive, Apparent), Power Factor, Load Percentage and Frequency.

4. The EMCS shall provide a EPSS Report showing the following sections:

   a. Devices Summary Section

      1) ATS and generator descriptions, and indication if the device was excluded from the report.

   b. ATS Summary Section

      1) Lead ATS, Required Transfer Time (Sec), Transfer Time (Sec). Detail with priority level and transfer time for each ATS in the test.

   c. Generator summary section

      1) Overall grade (pass/fail) of the test and the test evaluation method used.

   d. Generator Load Summary section.

1) Load graph:

a) Load evaluation method

(1) The graph shall compare recorded test data to the required load threshold.

b) Exhaust gas temperature evaluation method

(1) The graph shall compare recorded test data to the minimum required exhaust gas temperature.

c) Load bank testing method

(1) The graph shall compare applicable acceptable power load thresholds with the respective test data.

d) Minimum, maximum, and average table

(1) When using the load evaluation method, the minimum, maximum, and average table shall contain corresponding values for active power, apparent power, current per phase, L-N, and L-L voltages.

(2) When using the load bank testing method, the minimum, maximum, and average table shall contain corresponding values for each of the applicable stages.

e. Generator exhaust temperature summary section

1) Display the beginning and end date/time (HH:MM:SS) for the longest continuous temperature (LCT) at or above the manufacturer recommended minimum exhaust gas temperature.

2) In addition, display the manufacturer recommended minimum exhaust gas temperature, the required run duration (minutes) and the pass/fail status based on the LCT.

f. Exhaust temperature graph

1) Display the required manufacturer recommended minimum exhaust gas temperature and the actual recorded exhaust gas temperature data.

g. Minimum, maximum, and average exhaust temperature table

1) Display the minimum, average, and maximum exhaust temperature readings for longest continuous temperature at or above the minimum acceptable exhaust temperature.

h. Report Behavior

1) If the test solution has not been configured to collect exhaust temperature data, the entire Generator Exhaust Temperature Summary section shall not be shown and no warning message shall be shown.

5. EPSS Configuration.

a. Device Grouping.

1) The system shall provide a mechanism to group generators and ATS's functionally or logically for subsequent report generation based on these groups.

b. Evaluation Method.

1) The system shall support specifying one of the following five methods to evaluate a generator test:

a) Load

b) Exhaust Gas Temperature

c) Load Bank

d) Load or Exhaust Gas Temperature

e) Load and Exhaust Gas Temperature.

2) The system shall support setting pass/fail criteria based upon the exhaust gas temperature, and/or the electrical load, or load bank criteria.

c. The system shall support user configuration of the following:

1) Minimum manufacturer recommended exhaust gas temperature in degrees C or degrees F, when testing using Exhaust Gas mode.

2) Minimum required load as a percentage of generator nameplate rating, when testing using Load Test mode.

3) Load percentage and run duration for each applicable stage, when testing with Load Bank mode.

d. For each generator, the system shall support user assignment of a monitoring device or transducer measurement and an active value (logical 0 or 1) to the logical device start, running, and stopped engine parameters. This also includes other engine parameters such as oil pressure, battery voltage, tank level, etc.

1) ATS Device Configuration, for each ATS, the system shall support user configuration of individual priority level,

permissible transfer time, and a text description. The system shall also support:

a) Logical ATS measurement configuration, i.e., the ability to map logical ATS's to device or transducer based parameters.

b) Assigning a monitoring device measurement and an active value (logical 0 or 1) to the test, emergency and normal parameters.

c) Capturing and mapping the "Utility Power Available."

e. EPSS Report Configuration, the system shall support user configurability to:

1) Add an EPSS Report Group to include in the test report.

2) Exclude a subset of devices from the report group.

3) Choose "Reason for Running Report," to differentiate reporting on a test versus a real power outage.

4) Change report layout to selectively enable or disable displaying parameters such as the exhaust gas temperature graph, minimum/maximum, average voltage, current, power, frequency, and exhaust gas temperature data.

f. If data quality issues (for example, missing data) are encountered, the report shall display a warnings table with relevant information.

6. The EMCS shall provide a Generator Capacity Planning report customizable to accommodate the site's redundancy with the following features:

a. Display available capacity before the designed redundancy is compromised, or show if the system is oversubscribed and by how much.

b. Graphically display the level of redundancy of generator equipment during a user-selected time period.

c. Display the redundancy design limit.

d. Display the peak system load.

e. Display the calculated difference between the redundancy design limit and the peak system load.

7. When integrated with generator testing system, the EMCS shall be capable of Generator Fuel Monitoring and displaying fuel facility data including:

a. Volume of fuel is left in the tank.

b. Available run time available based on fuel levels and tank temperature.

c. Alarms shall also be set for leaks, low fuel levels, and water presence.

8. The EMCS shall provide a Generator Activity Report to list each instance the generator was run, categorize the reason (test, emergency etc.), and a cumulative total of emergency and non-emergency run time.

9. The EMCS shall show a comparison of the number of non-emergency hours compared with the allowable threshold (for example, 100 hours as per EPA in the US) for the reporting period for each generator.

10. The EMCS shall present a Generator Load Summary showing the electrical data captured during the run of a generator including a load graph with kW and kVA as well as a min/max/average summary table.

11. Optionally, the user can include a table containing the electrical details.

L. Capacity Management

1. The EMCS in conjunction with compatible connected power monitoring devices shall provide service and circuit load management with capacity planning compliant with NYCEC 220.87.

2. The EMCS shall provide sufficient information for operations and management decision-making for site expansion and modification planning in the form of dashboards, trending and reporting.

3. For the relevant circuits identified for capacity management reporting, report formats and dashboard layouts shall be specified in the “Software Configuration Standards and Conventions" document.

4. The following functionality shall be provided as a minimum:

a. Monitor or aggregate measurements to monitor source capacity to indicate degree of source loading.

b. For each circuit measured monitor maximum load and compare to equipment capacity to indicate the degree of equipment loading.

c. Identify when a user configurable threshold (for example, 80%) is exceeded.

d. Provide historical trending and reporting for loading on power sources and power distribution equipment such as automatic transfer switches, medium and low voltage switch gear, transformers, power distribution panels, uninterruptible power supply, etc.

e. Show the peak load provided by the transfer switch or other equipment during a time period and compare the peak load to equipment capacity.

f. Provide a summary of all transfer switches or equipment in a group or daily information for each piece of equipment in the group.

5. The EMCS in conjunction with connected power monitoring devices shall include a report to compare current state of the UPS system with thresholds for redundancy design.

6. The report shall help assess the available capacity of the UPS system(s) in relation to both UPS module de-rating and intended redundancy design (ex., N+1, N+2, 2N, 2(N+1), 2(N+2)). This report shall:

a. Report available capacity before designed redundancy is compromised, or show if the system is oversubscribed and by how much.

b. Graphically display UPS equipment in its redundancy configuration.

c. Show both graphically and in tabular format during the user-selected time period.

d. Show the redundancy design limit.

e. Show the peak system load.

f. Show the calculated difference between redundancy design limit and peak system load.

g. Show the information rolled-up to a system level, but also in increasingly more granular detail down to each UPS itself.

M. Utility Bill Verification

1. The EMCS in conjunction with connected revenue grade power and energy monitoring devices shall provide verification of Utility energy costs through internally generated “shadow bills”.

2. Billing determinants and billing report formats shall be specified in the “Software Configuration Standards and Conventions" document.

3. The following minimum functionality shall be provided.

a. Fully configured shadow energy billing report(s) that can be scheduled per a user-defined interval.

4. The EMCS shall provide a billing rate engine with the following capabilities.

a. Pre-engineered rate files for common Utility rate structures.

b. Support for rate schedule configuration and business logic through configuration files without custom programming

c. Support for common rate determinants including:

d. Energy usage (kWh, kVARh, kVAh)

e. Demand (kW, kVAR)

f. Power factor penalties

g. Co-incident demand

h. Time of use rates (off-peak, on-peak, etc.)

i. Seasonal rates (summer, winter, etc.)

j. Daily charges

k. Tiered or block energy rates (kWh)

l. Taxes

m. Dynamic rate formulas

5. Web based interface for rate schedule editing.

N. Energy Cost Allocation

1. The EMCS in conjunction with connected power and energy monitoring devices shall provide energy cost allocation features to encourage energy efficient behavior and support cost accounting by accurately allocating direct and indirect energy costs to departments / processes.

2. Energy cost determinants, report formats and dashboard layouts shall be specified in the “Software Configuration Standards and Conventions" document.

3. The following functionality shall be provided at a minimum.

a. Fully configured shadow energy cost allocation report(s) that can be scheduled per a user-defined interval.

b. Relevant cost allocation parameters represented in dashboard screens.

4. The EMCS shall provide cost allocation features to allow

a. Reporting on electrical energy costs for all energy sources.

b. Aggregating energy costs up to any point in the organizational hierarchy (areas, floor or buildings, cost centers etc.)

c. Configurable start and end dates for energy cost reporting.

d. Calculated apportionment by creating virtual measurements allocating percentages of physical meters, for example, 20% (Meter 2) + 80% (Meter 3).

e. Calculated net metering by creating summed or subtracted physical meters, for example, Meter 1 + Meter 2 – Meter 3.

f. Common area allocation to allocate calculated values to various entities in the organization hierarchy

g. Allocation of cost by standard time intervals, such as daily, weekly, monthly, yearly, or by specified time intervals like production shift

h. Data integrity checks including warnings for data gaps or duplicates.

i. Customization of energy cost reports to allow for custom logos and headers.

5. The EMCS shall provide the following user-configurable report templates to facilitate energy cost allocation.

   a. Billing report for any entity in the hierarchy with

      1) configurable time-periods and rate structures

      2) Itemized entries with each item in the rate structure and associated costs clearly specified

   b. Billing Summary Report for multiple entities in the hierarchy with

      1) Energy costs per entity represented as a subtotal section

      2) Grand Total for all entities

   c. Multiple Billing Report for multiple entities in the hierarchy with

      1) Each individual entity represented as a distinct section

      2) Itemized entries with each item in the rate structure and associated costs clearly specified

6. The EMCS shall be capable of exporting energy cost data, along with pertinent metadata, to integrate with external billing systems. The export mechanisms must be flexible with

   a. Support for common data file formats such as xml, csv and multiple files

   b. Support for XSLT transformations to customize format to match systems for billing, accounting, SAP, ERP etc.

7. The EMCS shall support customizing the cost allocation reporting to different environments such as:

   a. Building Environment:

      1) Energy cost while building occupied versus empty.

      2) Energy cost per occupant.

   b. Data Centers:

      1) Energy cost by colocation process area.

      2) Energy cost by PDU, rack etc.

   c. Industrial Environment:

1) Energy cost while in operation versus shut down, by shift etc.

2) Energy cost per unit of production.

d. Provide above comparisons in graphical format such as bar and pie charts.

O. Energy Usage and Benchmarking

1. The EMCS in conjunction with connected power and energy monitoring devices shall provide energy analysis and benchmarking features to isolate the factors contributing to energy usage, analyze energy usage patterns, and implement energy conservation measures.

2. The features must support common analysis and benchmarking activities such as

a. Categorize energy usage by load types to identify where to focus energy conservation initiatives

b. Compare energy usage across various areas, departments, plants, and processes.

c. Compare energy usage across multiple plant areas.

d. Analyze factors contributing to energy usage, usage patterns and isolate energy waste

e. Compare energy usage by normalizing consumption with respect to area, production volume or other energy drivers

3. The following information shall be specified in the “Software Configuration Standards and Conventions" document.

a. Energy usage determinants

b. Report formats and dashboard layouts.

c. Data import mechanisms to integrate normalization data from external systems like building management systems, production systems etc. when relevant.

d. Data import mechanisms to integrate operating state information from external systems like HVAC, production systems etc. when relevant.

4. The following functionality shall be provided at a minimum.

a. Fully configured energy analysis report(s) that can be scheduled per a user-defined interval.

b. Relevant energy analysis parameters, model and other performance parameters represented in dashboard screens.

c. Relevant energy analysis parameters represented in dashboard screens.

5. The EPMS shall provide the following report templates to support benchmarking initiatives to drive improved energy efficiency.

a. Energy Comparison report to display and compare the normalized energy consumption.

b. Energy Dashboards to compare the normalized energy consumption between sites or other organizational entities such as buildings, plants and processes.

c. Calendar Trend: Display energy data in interactive calendar views (monthly, weekly) with overlaid target lines.

d. Duration Curve: Display data organized by order of magnitude (rather than chronological) with overlaid target lines.

6. At a minimum, the EMCS shall support importing and logging the following parameters for normalization calculations.

a. Area (ft^2 or m^2)

b. Outdoor temperature

c. Humidity

d. Building occupancy

7. The EMCS shall provide the following functionality to support energy usage per-operating-state analysis to facilitate energy efficiency initiatives for operational systems such HVAC and industrial processes.

a. Calculate and display equipment energy and power consumption including percentages for electricity per operating state (e.g. Off, Normal, High, Free Cooling, etc.).

b. Calculate and display operational equipment statistics including hours of operation in each state/mode, percentage (%) hours in each state/mode, activations per each state/mode, and average duration operating in each state/mode.

c. The supplied report templates shall support

1) Configurable reporting/aggregation time periods, and state annotation.

2) Flexible output formats such as pie, stacked column, data table etc.

P. Energy Performance Analysis and Verification

1. The EMCS in conjunction with compatible connected power and energy monitoring devices shall provide modeling and analysis tools to determine

the factors contributing most to energy usage, find energy usage patterns, and implement energy conservation measures.

2. At a minimum, the EMCS shall support importing of the following energy driver data:
    a. Outdoor temperature,
    b. Humidity
    c. Building occupancy
    d. Process productivity
        1) Quantity of flow treated/pumped in unit time.
3. The following information shall be specified in the “Software Configuration Standards and Conventions" document.
    a. Energy usage determinants
    b. Report formats and dashboard layouts.
    c. Data import mechanisms to integrate energy driver information such as temperature, occupancy etc. when relevant.
4. The following functionality shall be provided at a minimum:
    a. Fully configured energy modeling report(s) that can be scheduled per a user-defined interval.
    b. Relevant energy model & performance parameters represented in dashboard screens.
5. The EMCS shall facilitate energy analysis through the following capabilities.
    a. Model data using linear regression or “best-fit” functions for assessing the relationship of two variables to find anomalies and track performance.
    b. Plot single or broken “best-fit” line and trend actual values against expected values based on linear regression calculations.
6. The EMCS shall provide the following user-configurable report template to facilitate energy modeling and verification:
    a. Represent the relationship between any measurement datasets through:
        1) X-Y scatter plot with overlay best-fit or broken-line regression lines
        2) Model summary table with model output variables - slope, Y-Intercept, R2, RMSE etc.
    b. Display measured values vs. expected (model output) values

c. Plot cumulative summation report to show cumulative deviation between measured values and expected values.

d. Support the following X Axis Calculation methods - Cooling Degree Days (CDD), Heating Degree Days (HDD), Average, Sum, Delta

e. Support the following Y Axis Calculation Methods – Average, Sum, Delta

f. Support data quality checks and optionally exclude missing data

Q. Power Quality Correction

1. The EMCS in conjunction with compatible connected active harmonic filters shall provide power quality correction and performance monitoring. Refer to Active Harmonic Filters specification for additional requirements.

2. The following shall be monitored at a minimum:

a. Per-phase total currents (source, load, output)

b. Per-phase fundamental currents (source, load, output)

c. Per-phase harmonics currents (load, output)

d. Fundamental powers - kW, kVAR, kVA (source, load)

e. Voltages (phase-to-phase, average)

f. THD currents per phase (source, load)

g. THD voltages line-to-line

h. Voltage harmonics line-to-line for odd-ordered harmonics (1st through 15th)

i. Per-phase current harmonics for odd-ordered harmonics (1st through 15th)

j. Device alarms (temperature alarms, trip signals, failure alarms, misconfiguration alarms etc.)

k. Device diagnostic data (configuration values, lifetime operating values, system capacity values)

R. Power Factor Correction

1. The EMCS in conjunction with compatible connected power factor correction equipment shall provide power factor correction and performance monitoring.

2. The EMCS system shall provide system power factor correction alarming, diagnostics and reporting for performance verification. Refer to Power Factor Correction specification for additional requirements.

3. The following shall be monitored at a minimum:

a. Power factor (target, measured total, measured displacement)

b. Total Power values (kW, kVAR, and kVA)

c. Average Current

d. Step settings & status of each step (whether closed, faulty, whether step type is automatic or fixed)

e. Step capacity for each step (initial, present and percentage remaining)

f. Device status information (line-to-line voltage, average current, temperature)

g. Device maintenance warnings & alarms (step broken, step power loss, hunting, over-under compensation, temperature alarms, operating hours exceeded, switching cycles exceeded etc.)

h. Device diagnostic data (operating hours, ambient temperature, overload current ratio, fan relay status etc.)

i. Device configuration settings (control sensitivity, step switch interval, discharge time etc.).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Certified Shop testing shall be performed on EMCS at the manufacturer's plant prior to Witnessed Shop Testing and shipment.

2. Certified Shop tests shall demonstrate that the equipment has been properly assembled, is operational and conforms to the specified requirements.

3. The Contractor shall provide a Certified Shop test report.

   a. The report shall identify the tests performed and the results obtained.

4. The Contractor shall carry out a full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of this Section, and the Contract Documents.

5. Demonstration of communication between connected equipment and devices or to remote I/O's shall be included in the Test Procedure where applicable .

6. The EMCS shall include the following:

   a. Provision of complete layout of the EMCS hardware and software

   b. Configure and load all software.

c. Test and operate computer and software in a simulated system mode for minimum of 48 hours.

d. Demonstrate full system functionality by including at least one device of each of the types specified under Connected Equipment , Connected Devices and Other Devices specified under this Section.

e. The devices shall be arranged to communicate information to the system computer to simulate operation and demonstrate performance.

7. Demonstration of HMIs and Printers

a. The overall display structure shall be demonstrated, including environment configurations, passwords, security, etc.

b. The display contents of memos shall be reviewed to demonstrate how an operator navigates within the overall display structure.

c. The assignment of displays to annunciator keys shall also be demonstrated.

d. Each graphic display shall be reviewed for correctness in terms of the layout, symbols, color scheme, etc.

e. The operation of standard alarm management displays (Current Alarm Display. Alarm History, etc.) shall also be demonstrated.

f. A demonstration of each type of report specified shall be performed.

g. Printing shall be an integral part of the report demonstration.

8. EMCS Hardware Operational Testing

a. All input/output devices and components shall be tested to verify operability and basic calibration.

b. All EMCS hardware components and associated equipment shall be tested to verify proper operation of the equipment as stand alone units.

c. Test shall include, but not be limited to, the following:

1) AC/DC power checks

2) Power fail/restart tests

3) Diagnostics checks

4) Test demonstrating that all specified equipment functional capabilities are working properly.

d. All system components shall be tested to verify that communication between units is working properly.

e. An integrated EMCS test with all system equipment connected (excluding field sensors and instruments) shall be performed to verify that· all equipment is performing properly as an integrated system.

1) All field sensors and instruments shall be simulated over their operating ranges inclusive of major set points.

9. EMCS Software Demonstration

a. Contractor shall demonstrate all system software utility and security programs incorporated into the EMCS to illustrate the various functions and capabilities specified.

b. Contractor shall demonstrate the operation and display of all software based on a simulation of 4 percent of total input/output count, both analog and discrete, as selected by the manufacturer.

c. The City/Engineer shall also randomly select, at the time of the test, additional inputs and outputs to be simulated in an amount approximately equal to 10 percent of total input/output count.

d. Demonstration shall show that the monitoring and control application software associated with the input/output points performs the functions intended.

e. System performance shall be tested using a fully integrated system, including all software and hardware.

1) To achieve this, the entire control system, including all the peripheral devices and all interconnecting cables, shall be assembled on the factory test floor and simulated inputs applied.

2) Every device shall have nameplate with description and device's P&ID tag number.

3) Nameplates shall be removable and interchangeable for multiple use during the test.

4) Simulated inputs/outputs shall at minimum include

a) Toggle switches to simulate field or other input contacts

b) Indicating lights to simulate outputs from tested panels

c) Control relays to simulate MCC coil inputs

d) Time relays to simulate position switches

e) Indications (mA) to indicate every 4-20 mA output from tested panel

f) Potentiometers to simulate 4-20 mA inputs to tested panel.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with the this Section and the Contract Documents.

2. The scheduling of the Witnessed Shop Test shall allow for the obtaining of all Departmental Administrative approvals and review and approval of the Certified Test Reports.

3. For the Witnessed Test the Contractor shall complete all the Certified Tests in the presence of the Witnesses.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. EMCS equipment shall be installed in accordance with manufacturer's instructions and recommendations.

B. EMCS equipment shall be installed so that sufficient access and working space is provided for ready and safe operation and maintenance.

C. EMCS equipment shall be installed at locations shown on the Contract Drawings.

D. EMCS equipment shall be securely mounted to mounting surfaces.

E. Anchor EMCS equipment to satisfy the specified seismic requirements in accordance with the anchorage details.

F. Install nameplates for identification of EMCS equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. EMCS Field Testing shall comply with the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

1. For the purposes of the EMCS Field Testing, replace all occurrences of PMCS in Section 40 80 82 with EMCS.

B. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the EMCS, check the EMCS installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations and train the Contractor and the City’s operations and maintenance staff in the care, operation and maintenance of the EMCS.

2. The Contractor shall provide EMCS equipment start-up services and training in accordance with this Section, and the Contract Documents and the following requirements:

3. Minimum number of manufacturer's representative site visits per switchgear:

Construction Phase	No of Visits	Person-Days	No of Day per Visit
Installation	2	1	1
Field Tests	2	1	1
Acceptance Testing	2	1	1
Training	1	1	2

4. Any additional time required to achieve a successful installation shall be at the expense of the Contractor.

5. The Engineer shall have the right to reallocate any unused person-days.

6. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site.

   a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.

7. The service representative shall sign in and out with the Engineer on each day they are at the site.

   a. Person-days shall be understood to be the actual time spent at site and does not include travel to and from the site.

3.04 STARTUP / DEMONSTRATION

A. EMCS startup and testing shall comply with the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. For the purposes of the EMCS Startup and Testing, replace all occurrences of PMCS in Section 40 80 82 with EMCS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 21 17 – LOW-VOLTAGE SERVICE ENTRANCE SWITCHBOARDS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing electrical service entrance Low-voltage equipment.

1. Electrical service entrance equipment shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The electrical service entrance equipment required under this Section shall be the Low-voltage type suitable for delivering electric energy from the Utility to the electric power distribution system of the facility served.

C. The electrical service entrance Work under this Section also includes coordination with the Utility and installation of the Utility metering equipment.

D. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 53 - Identification for Electrical Systems

B. Section 26 29 13 - Enclosed Controllers.

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Specifications shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

2. All references to the Electric Utility or Utility shall mean the Local Electric Utility having jurisdiction as defined in this Section and the Specifications.

3. The Local Electric Utility having jurisdiction is Con Edison.

B. Reference Standards

1. Electrical service entrance equipment shall comply with the latest applicable provisions and recommendations of the following:

a. Electric Utility. Con Edison

b. NYCEC - New York City Electrical Code

c. UL Standard No. 891 - Switchboards

d. NETA ATS - Acceptance Testing Specifications

e. NEMA PB-2 - Dead Front Distribution Switchboards

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General:

1. Contractor shall make all necessary arrangements with the Utility to obtain the service entrance supply. It shall be the responsibility of the Contractor to notify and coordinate in advance with the Utility to obtain the service required.

2. All Work regarding the service entrance supply and equipment shall conform to the requirements of the Utility.

3. The service entrance equipment shall be designed and built in accordance with the latest applicable editions of NEMA, UL, and the Utility.

4. The service entrance equipment shall be suitable as service entrance equipment and UL labeled as such.

5. The service entrance equipment manufacturer shall use a shop test facility that has a recently calibrated testing apparatus and qualified, experienced

technicians, for all factory tests. Calibration of testing apparatus shall be within one year.

6. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.

7. The service entrance equipment shall be field tested. Field testing shall be performed in accordance with the requirements specified under this Section.

8. The services of the service entrance equipment manufacturer shall be retained for field service. Field service shall be in accordance with the requirements specified under this Section.

9. Retain the service of an independent testing firm who shall perform field acceptance testing of the service entrance equipment. The testing firm shall have experience in the inspection and testing of service entrance equipment and shall be a member company of NETA. Acceptance testing shall be in accordance with the requirements specified under this Section.

B. Seismic Requirements:

1. The service entrance equipment shall be designed, constructed, and installed suitably for earthquake regulations in accordance with the seismic requirements of the City of New York Building Code and the Uniform Building Code for zone 2A application.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include but not be limited to:

1. Manufacturer's technical information which shall include:

a. Dimensional information.

b. Three-line diagrams.

c. Technical specifications.

d. Catalog cuts.

e. Construction details of enclosures.

2. Description of shop and field testing methods, procedures, and apparatuses with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 60 days in advance of actual testing.

3. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 60 days in advance to actual testing and five recent references with phone numbers.

4. Service entrance equipment anchorage details with design calculations signed by a licensed Professional Engineer, registered in the State of New York.

B. Certificates of Compliance:

1. Seismic qualification certification from the manufacturer, including mounting recommendations.

C. Reports:

1. Shop test and field test reports shall be submitted.

2. Manufacturer's site visit and acceptance testing reports shall be submitted.

D. Operations and Maintenance (O&M) Manuals

1. O&M Manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Service entrance equipment shall be delivered, stored and handled in accordance with this Section, the Contract Documents and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Service entrance equipment shall be as manufactured by:

1. General Electric Company, Fairfield, CT;

2. Eaton Corporation;

3. ABB;

4. Schneider/Square D

5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Service Entrance Equipment:

1. The service entrance equipment shall be dead front switchboard type construction, unless specifically shown or stated to be made a part of the Low-voltage switchgear.

2. The service entrance equipment shall consist of a Utility metering compartment and a main service disconnect.

3. The service entrance equipment shall be arranged with the number of sections and compartments as shown on the Contract Drawings. The metering compartment shall be constructed for hot metering sequence.

4. The service entrance equipment shall be equipped with a bonding jumper to bond the enclosure and ground bus to the neutral, a neutral disconnect link to disconnect the neutral and a barrier to isolate service bus bars and terminals.

5. Where shown on the Contract Drawings, the metering compartment and main service disconnect shall be made a part of the Low-voltage switchgear.

6. Ratings:

   a. The service entrance equipment shall be 600 volt class suitable for operation on a three-phase 60 hertz system.

   b. The system operating voltage, number of wires, bus ampacity and short circuit withstand capability shall be as shown on the Contract Drawings.

   c. The short circuit interrupting rating of the main service disconnect shall be as shown on the Contract Drawings.

7. Bus Bars:

   a. The service entrance equipment bus bars shall be tin-plated copper, supported by high impact, non-tracking insulating material. The bus joints shall be secured with bellevile type washers and shall be braced for the mechanical forces exerted during short circuit conditions.

   b. Bus bar sizes shall be based upon a maximum temperature rise of 65 degrees Celsius over a 40 degrees Celsius ambient in accordance with UL and NEMA.

   c. Bus bar sizes where applicable shall be based upon the requirements of the NYCEC.

   d. A ground bus shall be secured to each vertical section and shall extend the entire length of the service entrance equipment. The ground bus shall have a current capacity equal to 1/2 the capacity of the main power bus.

8. Structure:

   a. The service entrance equipment structure shall be completely self-supporting and shall include the required number of vertical sections bolted together to form one metal enclosed enclosure.

   b. The service entrance equipment enclosure shall be as follows:

      1) Non-Hazardous Locations

a) Indoor dry locations, enclosures shall be rated NEMA 12.

b) Outdoor locations, enclosures shall be rated NEMA 3R

c) Corrosive locations, enclosures shall be rated NEMA 4X

2) Hazardous Locations

a) Enclosures shall be NEMA 7.

3) Indoor and outdoor enclosures in corrosive locations shall be constructed from Type 316 stainless steel.

c. The enclosure structure frame shall be die-formed, 12-gauge steel bolted together and reinforced.

d. The service entrance equipment shall have identifying nameplates in accordance with the requirements of Section 26 05 53 - Identification for Electrical Systems.

9. Main Service Disconnect:

a. The main service disconnect shall be circuit breaker molded case type.

b. Molded case circuit breakers shall be in accordance with the requirements of Section 26 29 13 - Enclosed Controllers.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. All metal surfaces of the service entrance equipment enclosure shall be thoroughly cleaned and given one coat of zinc chromate primer.

2. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose enamel lacquer.

3. All exterior surface shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI No. 61

4. Stainless steel surfaces shall not be painted.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the service entrance equipment at the manufacturer’s plant prior to shipment. Shop test shall be in accordance with the latest revisions of ANSI and shall demonstrate that the equipment tested conforms to the requirements specified.

2. Service entrance equipment shop tests shall include the following:

a. Physical inspection shall be performed including torque tests of bus bolts.

b. Mechanical operations shall be performed to ensure proper functioning of operating mechanisms and interchangeability.

c. Continuity tests shall be performed on power and control wires.

d. Primary hi-potential tests shall be performed. Primary current carrying parts shall be tested between phases, phase to ground, and line to load. The applied voltage shall be twice rated voltage plus 1000 for one minute.

e. Hi-Potential tests on secondary wiring shall be performed. Secondary wiring shall be tested for 1500 volts to ground for one minute.

f. Power cables and buses shall be tested, for insulation breakdown resistance and circuit isolation. Test voltage frequency shall not be less than the frequency of the rated voltage of the equipment tested.

3. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with this Section and the Contract Documents.

2. Certified Shop Tests must be performed, and reports submitted and approved prior to the scheduling of Witnessed Shop Tests.

3. Obtain approval of the proposed testing procedure and proposed testing equipment layout prior to the scheduling Witnessed Shop Tests.

4. Service entrance equipment shall be witnessed tested in the presence of witnesses in compliance with the Contract Documents.

5. The Witnessed Shop Test shall at a minimum include those detailed under this Section at Certified Shop Tests and shall completely test all physical and functional aspects of the service entrance equipment as specified and shown on the approved Shop Drawings, including but not limited to all communication, monitoring, alarm, control interfaces and links to remote equipment.

6. The Contractor shall submit and obtain approval of the Engineer of a Witnessed Shop Test report. The report shall identify all the tests performed and the results obtained.

7. Service entrance equipment shall not be shipped until the Witnessed Shop Test report has been accepted and approved. The test shall be witnessed by the engineer and two DEP electrical engineers via video call. Shipping of the equipment shall be made after approval by the Engineer and both DEP electrical engineers.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Installation of Service Entrance Equipment

1. Service Entrance Equipment shall be installed in accordance with manufacturer's instructions and recommendations.

2. Service Entrance Equipment shall be installed so that sufficient access and working space is provided for ready and safe operation and maintenance.

3. Service Entrance Equipment shall be installed on concrete pads at locations shown on the Contract Drawings. Steel channels shall be provided for support of equipment. Equipment shall be securely mounted to surface with anchor bolts. Anchor service entrance equipment to satisfy the specified seismic requirements in accordance with the anchorage details.

   Install nameplates for identification of equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, service entrance equipment shall be field tested for operation and conformance. The Contractor shall perform field testing in accordance with this Section.

2. The field tests shall be witnessed by the Engineer and certified by the Contractor.

3. Service entrance equipment testing shall be performed by the manufacturer’s representative, prior to energizing equipment. The testing shall be in accordance with the recommendations of the manufacturer’s representative.

4. Equipment shall not be energized without the permission of the Engineer.

B. Acceptance Testing

1. The Contractor shall provide acceptance testing of the service entrance equipment. All acceptance testing shall be performed by the testing firm, after the completion of the Field Tests specified under this Section. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

2. Acceptance testing inspection shall be performed on each service entrance equipment. Inspection shall include the following:

   a. Physical, electrical and mechanical condition shall be inspected.

   b. Proper anchorage, required area clearances, physical damage and proper alignment shall be checked.

c. All electrical connections shall be inspected for high resistance.

d. Insulators shall be inspected for evidence of damage or contamination.

e. Equipment shall be cleaned and lubricated as required.

3. Acceptance electrical testing shall be performed on each service entrance equipment. Testing shall include the following:

a. Ground-resistance tests shall be performed.

b. Insulation-resistance tests shall be performed on each bus section and circuit breaker, phase-to-phase and phase-to-ground.

c. An over potential test shall be performed on each bus section, each phase-to-ground.

d. Contact-resistance test shall be performed.

e. Circuit breaker trip characteristics shall be determined by primary current injection

f. Protective devices shall be set based upon approved Power System and Arc Flash Studies.

4. All tests and values shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.

5. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

C. Manufacturer's Field Services

1. The Contractor shall furnish the services of a qualified manufacturer's service representative to assist in the installation of the service entrance equipment, check the service entrance equipment installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations, and train the plant operations and maintenance staff in the care, operation, and maintenance of the service entrance equipment.

2. The Contractor shall provide equipment start-up services and training in accordance with this Section and the Contract Documents.

3. The Contractor shall provide the services of the representative for the at least durations shown in the Table 1.

Table 1 - Required Schedule of Manufacturer's Visits

Visit Type	Min .Number of Visits	Days per Visit	Min. No. of Person-Days for Visit Type
Equipment Installation and Inspection	1	5	5
Field Tests	1	5	5
Acceptance Testing	1	5	5
Training	1	5	5

4. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

5. The service representative shall sign in with the Engineer on each day they are at the Site.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing Integrated Service Equipment. Integrated Service Equipment shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The Integrated Service Equipment required under this Section shall be the Low-voltage type, with outdoor, weatherproof, non-walk-in enclosures, and approved by Con Edison, NYC DOB, DEP, and the Engineer.

The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Special Warranty Provisions / Guarantee Periods	6
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	12
3.01	Examination / Preparation	12
3.02	Installation	12
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 53 – Identification for Electrical Systems

B. Section 26 05 14 – Medium-Voltage Cables and Accessories

C. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems

D. Section 26 21 17 – Low-Voltage Service Entrance Switchboards

1.04 REFERENCES

A. Definitions

1. All references to the Electric Utility or the Utility shall mean the Local Electric Utility having jurisdiction.

2. The Electric Utility or Utility is Con Edison.

3. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation at less than 1000 volt and within the 600 VAC Class.

4. Medium-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation above 1000 volts and below 99,000 volts.

B. Reference Standards

Equipment shall comply with the latest applicable provisions and recommendations of the following:

1.	IEEE C37.13	-	Low-Voltage AC Power Circuit Breakers Used in Enclosures
2.	IEEE C37.16	-	Preferred Ratings. Related Requirements, and Application Recommendations for Low-Voltage AC (635 VAC and below) and DC (3200 DC and below) Power Circuit Breakers
3.	IEEE C37.20.1	-	Metal-Enclosed Low-Voltage (1000 VAC and below and 3200 VDC and below) Power Circuit Breaker Switchgear
4.	IEEE C57.12.01	-	General Requirements for Dry-Type Distribution and Power Transformers
5.	IEEE C57.12.51	-	Guide for the Interchangeability of Ventilated Dry-Type Power Transformers
6.	IEEE C57.12.91	-	Test Code for Dry-Type Distribution and Power Transformer
7.	IEEE C57.94	-	Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type Distribution and Power Transformers
8.	NYCEC	-	New York City Electrical Code
9.	NEMA TR1	-	Transformers, Step-Voltage Regulators and Reactors
10.	NETA ATS	-	Acceptance Testing Specifications

11. NIST - National Institute of Standards and Technology

1.05 DESCRIPTION

A. Integrated Service Equipment No. 1 shall consist of:

1. One underground ductbank with ten five-inch RGS conduits and LV cables from existing property line manhole to service end box.
2. One Incoming Section or service end box with CU details drilled for limiters, and ten 500 kcmil copper cables per phase and 100% neutral, plus ground, per Con Edison specifications.
3. One Utility Metering Section, 4000A, 208/120V, three-phase, four-wire, provisions for mounting 4000/5 current transformers (CTs) and watthour meter, per Con Edison specifications (CTs and meter furnished by Con Edison).
4. One Service No. 1 Main Breaker, 4000A, 208V.
5. One Transformer Section 208V to 480V, 1250 kVA, cast-coil dry-type.
6. One Service No. 1 Secondary Breaker, 1600A, 480V.

B. Integrated Service Equipment No. 2 shall consist of:

1. One property line manhole type M11 and underground ductbank with two five-inch FRE conduits (one spare) and MV cables from manhole to transformer.
2. One concrete pad and installation of pad-mounted transformer (transformer furnished by Con Edison), per Con Edison specifications.
3. One Utility Metering Section, 1600A, 480V, three-phase, three-wire, provisions for mounting 1600/5 current transformers and watthour meter, per Con Edison specifications (CTs and meter furnished by Con Edison).
4. One Service No. 2 Main Breaker, 1600A, 480V.
5. Payment of Excess Distribution Fee (EDF) to Con Edison.

C. The arrangement of each Integrated Service Equipment shall be as shown on the Contract Drawings.

1.06 QUALITY ASSURANCE

A. General

1. Integrated Service Equipment (“Equipment”) shall be designed, built, and tested in accordance with the latest applicable editions of IEEE, NEMA, UL, NFPA and the NYCEC.
2. Where applicable Equipment shall be constructed as service equipment in accordance with the requirements of the Utility and NYCEC.
3. The Contractor is responsible for submitting all applicable drawings for the required approvals including the NYCDOB and the Utility.

4. The costs of the Equipment drawing submission and any resubmissions shall be included for payment in the lump sum price bid for the Work under this Contract.

5. Each Equipment section shall be separated from the others by steel barriers but electrically connected and physically joined to form a single, metal-enclosed structure arranged to form a continuous lineup.

6. Where specifically shown on the Contract Drawings, each Equipment shall be arranged in segments. The arrangement of each Equipment segment shall be as shown on the Contract Drawings.

7. All structures shall be fabricated of code gauge steel. Steel surfaces shall be chemically cleaned, treated, and finished with ANSI No. 61 indoor light grey paint.

8. The Equipment manufacturer shall use a shop test facility that has a recently calibrated testing apparatus and qualified, experienced, technicians for all factory tests. Calibration of testing apparatus shall be within one year.

9. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. NIST and NETA ATS.

B. Seismic Requirements

1. The Equipment shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

C. Field Tests:

1. The Equipment shall be field tested. Field testing shall be performed in accordance with the requirements specified under this Section.

2. The services of the Equipment manufacturer shall be retained for field service. Field service shall be in accordance with the requirements specified under this Section.

3. Retain the service of an independent testing firm who shall perform field acceptance testing of the Equipment. The testing firm shall have experience in the inspection and testing of Equipment and shall be a member company of NETA. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer. Acceptance testing shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's technical information, which shall include:

a. Dimensional and weight information.

b. Single-line diagrams

c. Three-line diagrams.

d. Technical specifications.

e. Catalog cuts.

f. Construction details of enclosures.

2. Description of shop and field-testing methods, procedures, and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 90 days in advance prior to conformation of witness testing dates and actual testing.

3. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 90 days in advance to actual testing; five recent references with phone numbers shall be submitted.

4. Equipment anchorage details with design calculations signed by licensed Engineer.

B. Certificates of Compliance:

1. Seismic qualification certification from the manufacturer including mounting recommendations.

2. Cybersecurity Equipment Certification

3. Data and results of witness tests accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to Site shall proceed.

C. Reports:

1. Shop test and field test reports shall be submitted.

2. Manufacturer's Site visit and acceptance testing reports shall be submitted.

D. Operation and maintenance

1. Operation and Maintenance manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be delivered, stored and handled in accordance with this Section, the Contract Documents, the manufacturer's instructions, and the following.

1. Equipment shall be inspected for shipping damage or loose parts when received.

2. Evidence of water which may have entered equipment during transit shall be checked.

3. Equipment shall be lifted, rolled or jacked into locations shown on the Contract Drawings.

4. Switchgear shall be handled and placed in position without circuit breakers.

5. Equipment shall be stored in a clean, dry location in which a uniform temperature is maintained.

6. Equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.

7. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for the Equipment in accordance with this Section and the Contract Documents.

B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. Spare parts shall be furnished in accordance with the manufacturer's recommendations.

D. Spare parts for each Equipment shall include at a minimum the following:

1. Spare feeder breakers shall be provided in the quantities and sizes as indicated on the Contract Drawings.

2. One set of power fuses shall be provided of each size and type used.

3. Two sets of control power fuses shall be provided of each type and size used.

4. Two per ten pilot lights shall be provided of each type used.

5. One spare key shall be provided for each key interlock system.

6. Breaker lifting device shall be provided. Breaker lifting device shall be capable of inserting and removing any breaker from the disconnect position of any compartment.

7. Breaker moving device shall be provided. Breaker moving device shall be capable of moving any breaker into and out of any compartment and around the switchgear room.

1.10 SPECIAL WARRANTY PROVISIONS / GUARANTEE PERIODS

A. Service and Maintenance Agreement

1. The Equipment manufacturer’s guarantee shall include all equipment furnished under this Section against defects in workmanship and material for a period of twenty-four (24) months from the date of installation in the field and approved equipment demonstration in the field. After the twenty-four month guarantee period expires, the Contractor shall furnish a Service

and Maintenance Agreement for a period of three (3) years beyond the guarantee period.

2. All costs for labor, transportation, freight, and replacement parts required to satisfactorily repair any piece of equipment as a result of equipment malfunction during the guarantee period shall be considered to have been included in the lump sum price bid for providing the Equipment.

3. The Service and Maintenance Agreement shall cover maintenance as well as emergency repairs. The agreement shall at a minimum include the following:

   a. All maintenance recommended by the manufacturer, including checkout, inspection, and maintenance of all furnished components and wiring once per year.

   b. All parts, labor, and other expenses associated with providing emergency (within 48-hours) on-Site repairs, regardless of the reason for failure excepting misuse or vandalism.

   c. A report shall be submitted after each Site visit describing the problem, solution, all work performed, and parts replaced.

4. All Work covered by the service and maintenance agreement shall be performed by the Equipment manufacturer or authorized representative. The cost of this agreement shall be included in the lump sum price bid for the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Equipment shall be as manufactured by:

1. Schneider Electric, Andover, MA.
2. ABB, New Berlin, Wisconsin.
3. Siemens, Washington, DC
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Medium-Voltage Cables and Equipment for Service No. 2

1. The medium-voltage cables and accessories shall comply with Con Edison specifications and Section 26 05 14 – Medium-Voltage Cables and Accessories.
2. The Contractor shall provide medium-voltage ductbank, conduits, cables, and accessories from the property line manhole to the pad-mounted transformer.

3. Con Edison shall provide the utility pole outside the property line, medium-voltage conduit, and cables from the pole to the property line manhole, pad-mounted transformer, and medium-voltage switches, fuses, and devices on the utility pole and/or inside the pad-mounted transformer.

B. Transformer for Service No. 1

1. The transformer for Service No. 1 shall be solid-cast dry-type construction designed for three-phase, 60 Hertz, with delta connected primary, wye connected secondary, with the neutral brought out through a bushing.

2. Transformers shall have an impedance of 5.75 percent and an efficiency of 98 percent minimum.

3. Transformer kVA capacity and primary and secondary voltages shall be as shown on the Contract Drawings.

4. BIL Rating shall be as follows:

   a. 5 kV windings - 60 kV.

   b. 15 kV windings – 95 kV.

   c. Low-voltage windings - 10 kV.

5. Transformer winding construction shall be in accordance with the following:

   a. Epoxy resin shall be rated 185 degrees Celsius used throughout the construction.

   b. Winding temperature rise shall not exceed 80 degrees Celsius above 40 degrees Celsius ambient.

   c. Cores shall be silicon steel construction assembled and rigidly clasped to ensure mechanical strength and to reduce vibration.

   d. Core shall be grounded to the frame with a flexible grounding strap.

   e. Windings shall be copper and have high dielectric and mechanical strength insulation.

   f. Coils shall be sized, insulated, and supported for short circuit forces and be impervious to moisture.

   g. The windings shall withstand impulse, induced, and dielectric test voltage and short circuit testing without damage.

   h. The high voltage primary windings shall be disc wound for enhanced voltage stress distribution and to facilitate complete epoxy penetration.

   i. The high voltage primary windings shall be completely impregnated and cast in epoxy resin under vacuum in molds and be oven cured.

   j. The Low-voltage secondary winding shall be resin encapsulated by winding epoxy-impregnated insulation. All exposed surfaces shall

be covered and sealed with epoxy. The entire winding shall be oven cured.

6. Transformers shall be equipped with six 2-1/2 percent fully rated taps. Taps shall include two-2-1/2 percent primary taps above normal and four-2-1/2 percent primary taps below normal.

7. Easily accessible bolted tap links in the high-voltage windings shall permit the changing of taps only when the transformer is de-energized.

8. Transformer enclosure shall be grounded heavy gauge sheet steel. The transformer enclosure shall include ventilation louvers, removable panels for access to taps, and vibration isolating pads.

9. Each transformer enclosure shall be equipped with a diagrammatic nameplate showing details of the winding configuration, tap connections, and voltages.

10. Transformers shall be equipped with provisions for future forced air-cooling equipment. Transformer components shall be suitable for the forced air rating.

11. Where specifically shown on the Contract Drawings, forced-air cooling equipment shall be provided.

12. The forced-air cooling equipment shall increase the transformers output rating by 33.33 percent without modification to the transformer core and windings and shall include:

    a. Cooling fans shall provide air cooling of windings.

    b. Temperature probes embedded in the windings shall provide sensing of temperature.

    c. Fused control power transformer shall provide supply for cooling fans and control unit.

    d. Electronic control unit with digital display shall provide monitoring and control of the transformers. The control shall permit manual and automatic operation of the fans and temperature readings of the windings.

    e. Hardware necessary for mounting air-cooling equipment shall be provided within the transformer enclosure.

13. The transformer enclosure shall have high voltage signs in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems.

C. Low-Voltage Service Entrance Switchboard

1. The low-voltage service entrance switchboard, including service end box or section, utility metering section, main circuit breaker section, and secondary

breaker section, shall be provided in accordance with Section 26 21 17 - Low-Voltage Service Entrance Switchboards.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. All metal surfaces of the Equipment/s shall be thoroughly cleaned and given one coat of zinc chromate primer.

2. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose lacquer enamel.

3. All exterior surfaces shall be given three coats of the same lacquer. The color of the exterior finishing coats shall be light gray ANSI No. 61.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the Equipment at the manufacturer's plant prior to shipment.

2. Shop test shall be in accordance with the latest revisions of IEEE and ANSI and shall demonstrate that the equipment tested conforms to the requirements specified.

3. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

4. Switchgear shop tests shall include the following:

a. Physical inspection shall be performed including torque tests of bus bolts.

b. Mechanical operations shall be performed to ensure proper functioning of operating mechanisms and interchangeability.

c. Continuity test shall be performed on power and control wires.

d. Functional operations test which shall include pick up, dropout, time delay, sequence, and polarity.

e. Primary hi-potential tests shall be performed. Primary current carrying parts shall be tested between phases, phase to ground, and line to load. The applied voltage shall be twice rated voltage plus 1000V for 1 minute.

f. Hi-Potential tests on control and secondary wiring shall be performed. Control circuit wiring shall be tested for 1500 volts to ground for one minute.

g. Power cables and buses shall be tested for insulation breakdown resistance and circuit isolation. Test voltage frequency shall not be less than the frequency of the rated voltage of the equipment tested.

5. Transformer shop tests shall include the following:

a. Resistance measurements of all windings shall be performed on the rated voltage connection.

b. Ratio test on the rated voltage connection and on all tap connections shall be performed.

c. Polarity and phase relation tests on the rated voltage connection shall be performed.

d. No load loss at rated voltage on the rated voltage connection shall be performed.

e. Excitation current at rated voltage on the rated voltage connection shall be performed.

f. Impedance and load loss at rated current on the rated voltage connection shall be performed.

g. Applied potential tests shall be performed.

h. Induced potential test shall be performed.

i. High potential test shall be performed.

j. Temperature rise test at both AA and FA ratings shall be performed.

B. Witnessed Shop Tests:

1. The Contractor shall perform Witnessed Shop Tests in accordance with this Section and the Contract Documents.

2. The Witnessed Shop Test shall not be scheduled before the approval of the Certified Shop Tests.

3. For the Witnessed Shop Test, the Contractor shall perform all of the Certified Tests in the presence of the witnesses.

4. For Witnesses Shop Tests, the Equipment shall be fully assembled. Jumpering of shipping splits is not acceptable.

5. The Contractor shall provide a Shop Test Report. The report shall identify the tests performed and the results obtained.

6. Equipment shall not be shipped before the approval of the Witnessed Shop Test Report.

7. Switchgear shop tests shall be witnessed by the Engineer and two DEP electrical engineers for their approval before shipping. The Engineer and DEP representatives shall be present in person for all shop witnessed tests. However, the Engineer and DEP representatives may opt to witness the shop tests via video call at their discretion

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Equipment shall be installed in accordance with manufacturer's instructions and recommendations.

B. Equipment shall be installed so that sufficient access and working space is provided for ready and safe operation and maintenance.

C. Equipment shall be installed on concrete pads at locations shown on the Contract Drawings.

D. Steel channels shall be provided for support of Equipment.

E. Equipment shall be securely mounted to mounting surface with anchor bolts.

F. Anchor Equipment to satisfy the specified seismic requirements in accordance with the anchorage details.

G. Install nameplates for identification of Equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. After installation, Equipment shall be field tested for operation and conformance.

B. The Contractor shall perform field tests in accordance with this Section and the Contract Documents.

C. The field tests shall be witnessed by the Engineer and certified by the Contractor.

D. Equipment testing shall be performed by the manufacturer's representative, prior to energizing equipment.

E. Equipment shall not be energized without the permission of the Engineer.

F. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall consist at a minimum of the following:

1. Device settings and adjustments shall be verified.
2. Mechanical and electrical interlocks shall be inspected and controls shall be checked for proper operation.
3. Functional tests verifying the operations of all controls and displays.

G. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the Equipment, check the Equipment installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations, and train the Contractor and the City’s operations

and maintenance staff in the care, operation, and maintenance of the Equipment.

2. The Contractor shall provide Equipment start-up services and training in accordance with this Section, and the Contract Documents, and the following requirements:

   a. Minimum number of manufacturer's representative site visits per Integrated Service Equipment:

Construction Phase	No of Visits	Person-days per visit
Installation	2	2
Field Tests	2	2
Acceptance Tests	2	2
Training	1	1

3. Any additional time required to achieve a successful installation shall be at the expense of the Contractor.

4. The Engineer shall have the right to reallocate any unused person-days.

5. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

6. The service representative shall sign in and out with the Engineer on each day they are at the Site. Person-days shall be understood to be the actual time spent at Site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. The Contractor shall provide Equipment start-up services and Training in accordance with this Section and the Contract Documents.

B. Acceptance Testing

1. The Contractor shall provide acceptance testing of the Equipment.

2. All acceptance testing shall be performed by the testing firm, after the completion of the field tests specified under this Section.

3. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

4. Acceptance testing inspection shall be performed on each Equipment. Inspection shall include the following:

   a. Physical, electrical and mechanical condition shall be inspected.

   b. Proper anchorage, required area clearances, physical damage, and proper alignment shall be checked.

c. All connections shall be inspected for high resistance.

d. Electrical and mechanical interlock systems shall be checked for proper operation.

e. Switch arc chutes, blade alignment, and arc interrupter operation shall be checked.

f. Insulators shall be inspected for evidence of damage or contamination.

g. Equipment shall be cleaned and lubricated as required.

5. Acceptance electrical testing shall be performed on each Equipment. Testing shall include the following:

a. Ground-resistance tests shall be performed.

b. Insulation-resistance tests shall be performed on each bus section, on each switch, transformer and circuit breaker, phase-to-phase, and phase-to-ground.

c. An over potential test shall be performed on each bus section, each phase-to-ground and on each switch in the closed position. Test each pole with other poles grounded.

d. Contact-resistance test shall be performed.

e. Control and metering wiring performance test shall be performed.

f. Circuit breaker trip characteristics shall be determined by primary current injection.

6. All tests and values shall be in accordance with the manufacturer's recommendations and NETA ATS.

7. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 22 13 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing individually mounted dry type transformers. Dry type transformers shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The following index of this Section is included for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	6
3.05	Adjusting / Protection / Cleanup	6

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 27 - Grounding

B. Section 26 05 29 - Hangers and Supports for Electrical Systems

C. Section 26 05 53 - Identification for Electrical Systems

1.04 REFERENCES

A. Dry type transformers shall comply with the latest applicable provisions and recommendations of the following:

1.	NYCBC	-	New York City Building Code
2.	NYCEC	-	New York City Electrical Code
3.	UL 1561	-	Dry-Type General Purpose and Power Transformers
4.	NEMA ST 20	-	Dry Type Transformers for General Application

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General:

1. All transformers shall conform to the applicable NEMA, ANSI, and IEEE Standards and shall be built by one approved manufacturer who shall use only the best commercial materials and processes of manufacture.

2. Transformer enclosures shall have ample room for primary and secondary wiring connections.

3. All transformers shall be UL listed and certified to ANSI/NEMA sound levels.

4. The transformer manufacturer shall use a shop test facility that has a recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year of date of testing.

5. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology. Calibration of testing apparatus shall be within one year of date of testing.

B. Seismic Requirements

1. The transformer mounting system shall be designed, constructed, and installed suitably for earthquake regulations in accordance with the seismic requirements of the NYCBC.

2. Transverse and longitudinal bracing shall be provided as required to brace the transformer for the seismic requirements specified.

C. Field testing of the transformers shall be performed in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's catalog cuts for the transformers proposed for use.
2. Dimensional drawings showing transformer details with diagrammatic nameplate.
3. Transformer anchorage and mounting details prepared and stamped by a licensed Professional Engineer, registered in the State of New York.
4. Description of shop and field testing methods, procedures, and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 60 days in advance prior to confirmation of witness testing dates and actual testing.

B. Shop test and field test reports shall be submitted.

C. Operations and Maintenance Manuals shall be submitted in accordance with the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Dry type transformers shall be delivered, stored, and handled in accordance with this Section, the Contract Documents, and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dry type transformers shall be as manufactured by:

1. General Electric Company, Stamford, CT.
2. Eaton Corporation;
3. ABB;
4. Schneider/Square D
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General Purpose Transformers

1. General purpose transformers shall be of the dry, commercially quiet, low temperature rise type consisting of two windings per phase.
2. Transformers shall have kVA rating, primary voltage and connection, secondary voltage and connection and number of phases as shown on the Contract Drawings.
3. Conductors for transformer windings shall be copper only.
4. Transformers shall be suitable for indoor or outdoor installation in accordance with the locations shown on the Contract Drawings.
5. Transformer insulation shall be rated 220 degrees C, 80 degrees Celsius rise.
6. Transformers shall be equipped with six 2-1/2 percent fully rated taps, two above and four below the rated voltage tap on the primary winding.
7. The arrangement, assembly, and laminations of the core shall be such as to facilitate repair to the windings.
8. The design, shape, and arrangement of windings shall allow free flow of air for insulation and cooling.

B. Shielded Isolation Transformers

1. Shielded isolation transformers shall conform to the requirements specified under this Section for General Purpose Transformers and the following:
   a. Shielded isolation transformers shall also include an electrostatic shield, grounded to the transformer case, to attenuate electrical noise.

C. Non-Linear Load Transformers

1. Non-linear load transformers shall conform to the requirements specified under this Section for General Purpose Transformers and the following:
   a. Non-linear load transformers shall be specifically designed for non-sinusoidal loads.
   b. Transformers shall be K-factor rated as shown on the Contract Drawings.
   c. Transformers shall be provided with oversize neutral suitable to handle at least 200 percent of normal phase current.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop Tests

1. Shop tests shall be performed at the transformer’s manufacturer’s plant prior to shipment.

2. Shop tests shall demonstrate that the equipment tested conforms to the requirements specified.
3. Each transformer shall be given a routine test in accordance with the latest requirements of UL, ANSI and NEMA standards.
4. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
5. Transformer shop tests shall be performed consisting of the following:
    a. Applied potential shall be performed.
    b. Induced potential shall be performed.
    c. No load losses shall be performed.
    d. Voltage ratio shall be performed.
    e. Polarity shall be performed.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Transformers shall be installed on walls or floors. Floor mounted transformers shall be installed on one inch of Korfund sound absorber material on raised concrete base at locations shown on the Contract Drawings.

B. Sufficient access and working space shall be provided for ready and safe operation and maintenance.

C. Transformers mounting, supports and restraints shall confirm to the requirements of this Section and Section 26 05 29 – Hangers and Supports for Electrical Equipment.

D. Transformers shall be grounded in accordance with the requirements of Section 26 05 27 – Grounding and as shown on the Contract Drawings.

E. The transformer leads shall be provided with solderless, clamp-type cable connectors.

F. Conduit runs shall be arranged for easy removal of the transformers.

G. Transformer nameplates shall be installed for identification of equipment. Nameplates shall be provided in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems.

3.03 FIELD TESTING / QUALITY CONTROL

A. Insulation resistance tests shall be performed on the transformers after installation.

B. The tests shall be witnessed by the Engineer and certified by the Contractor. The tests shall be performed by the Contractor who shall furnish all testing equipment.

C. The Contractor shall provide a field test report. The report shall identify the tests performed and the results obtained.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install, test, and place into satisfactory operation Switchboards (SWBDs) as shown on the Contract Drawings and as specified in this Section.

B. Furnish and install the SWBDs with all auxiliary equipment and accessories as shown, specified, and /or required for the proper operation of the following:

1. One (1) new 480 VAC Generator Switchboard.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	9
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	16
2.04	Source Quality Control / Shop Tests	16
PART 3	EXECUTION	18
3.01	Examination / Preparation	18
3.02	Installation	18
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	22
3.05	Adjusting / Protection / Cleanup	23

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 11 - General Electrical Requirements.

B. Section 26 05 27 - Grounding.

C.	Section 26 05 48	-	Vibration and Seismic Controls for Electrical Systems.
D.	Section 25 05 53	-	Identification for Electrical Systems.
E.	Section 26 05 73	-	Power System Studies.
F.	Section 26 05 75	-	ShockHazard and Arc Flash Studies.
G.	Section 26 06 11	-	Cable and Conduit Schedule.
H.	Section 26 09 13	-	Electrical Monitoring and Communication System
I.	Section 26 43 13	-	Low-Voltage Surge Protective Devices.

1.04 REFERENCES

A. Definitions

1. SWBD as used in this Section and the Contract Documents shall mean a large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent, and other protective devices, buses, and usually instruments. These assemblies are completely accessible from the front only and are not intended to be installed in cabinets.
2. All references to the Electric Utility or the Utility shall mean the Local Electric Utility having jurisdiction.
    a. The Local Electric Utility is Con Edison.
3. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation at less than 1000 volt and within the 600 VAC Class.
4. NIST as used in this Section and the Contract Documents shall mean the National Institute of Standards and Technology.

B. Reference Standards

1.	IEEE C57.13	-	Instrument Transformers
2.	NEMA KS1	-	Heavy Duty and Dead-Front Switches (600 V Maximum)
3.	NEMA PB2	-	Dead-Front Distribution Switchboards
4.	NYCBC	-	New York City Building Code.
5.	NYCEC	-	New York City Electrical Code.
6.	NETA ATS	-	NETA Acceptance Testing Specifications.
7.	UL 98	-	Enclosed and Dead-Front Switchboards.
8.	UL 489	-	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
9.	UL 891	-	Dead-Front Switchboards.

10.	UL 943	-	Ground-Fault Circuit Interrupters.
11.	UL 1283	-	Electro-Magnetic Interference Filters.
12.	UL 1449	-	Surge Protective Devices
13.	UGS	-	Utility Governing Specifications.

1.05 DESCRIPTION

A. SWBDs installed under this Contract shall be free-standing, dead-front, front-accessible only, low-voltage types intended to serve as marshalling points for power, lighting, control, and instrumentation feeders distributing power within the facilities being constructed, renovated, modified, or upgraded under this Contract.

B. SWBDs shall be complete with all accessories and instrumentation and only require installation, connection of source, and outgoing circuits and testing to be brought into service

C. Where specifically shown on the Contract Drawings, each SWBD shall be arranged in segments.

1.06 QUALITY ASSURANCE

A. SWBD equipment shall be designed, built, and tested in accordance with the latest applicable standard editions of IEEE, NEMA, UL, the Utility, and NYCEC.

B. The SWBD manufacturer shall be the manufacturer of all the major components of the SWBDs as specified in this Section, and as per the Contract Documents.

C. All SWBD equipment shall be new within six months of manufacture and compliant with the requirements of this Section and the Contract Documents.

D. The manufacturer of the SWBD equipment shall have produced SWBDs for a minimum period of the last continuous fifteen (15) years.

E. The SWBD manufacturer shall maintain a documented Quality Assurance Program implementing suitable procedures and controls to monitor all aspects of production and testing.

1. The Quality Assurance Program shall be the manufacturer's standard program specifically dedicated to ensure that each SWBD and its components are designed, assembled, and tested in accordance with the requirements specified in this Section, and the Contract Documents.

F. SWBDs shall be UL listed.

G. Whenever applicable, all Work regarding the SWBD equipment shall conform to the requirements of the Utility.

H. All cable and wire terminations at the SWBD equipment terminations shall be done by experienced installers who have worked with similar SWBD equipment for a period of at least five years, using materials and procedures recommended by the SWBD manufacturer.

I. The Contractor shall provide list of at least five (5) installations with similar SWBD equipment, to that which will be provided under this Contract, and demonstrating compliance with these requirements.

1. The Contractor will provide the name, address, telephone number, and email of the Company representative who can speak to enquires in relation to the procurement, installation, commissioning, and operation of the SWBD equipment at the above-listed five installations.

J. The Contractor shall retain the services of the SWBD manufacturer's representative to certify that the SWBD installation is in accordance with the manufacturer's requirements.

K. Where SWBDs are to be installed to conform with Contract or Utility requirements, each SWBD shall be physically separated from other SWBDs in conformity with Utility requirements and/or as shown on the Contract Drawings.

L. Seismic Requirements

1. The Contractor shall provide SWBDs designed, constructed, and installed suitably for earthquake regulations in accordance with the seismic requirements of Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems and the NYCBC.

M. Testing

1. The SWBD manufacturer shall use a shop test facility that has a calibrated testing apparatus and qualified experienced technicians for all shop tests.

2. Calibration of all testing apparatus shall be within one year.

3. Shop testing shall comply with the requirements in this Section and the Contract Documents.

4. Field testing shall comply with the requirements in this Section and the Contract Documents.

5. All test equipment, instrument calibration, and test reports shall be in accordance with the latest edition of the accuracy standard of NIST and NETA ATS.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for approval by the Engineer.

B. Submittals shall include, but not be limited to, the following:

1. Certified copy of the manufacturer’s Design Tests made in accordance with UL 891 and conducted on SWBD models and type that is being offered for this contract.

2. Certified dimensioned outline drawings showing equipment layouts, front view, and floor plan in sufficient detail to define space required for

dismantling and maintenance, exact location of and space available for conduit entrance, and the interrelationship of the various components.

3. Cross sections and details, as required, to satisfy the Engineer that all components conform with specification requirements, including design and physical arrangement.
4. All information required by the Engineer for the design and location of all connecting structural, mechanical, or electrical items such as piping, ducts, cables, conduits, etc.
5. Weight of the SWBD and all associated equipment and distribution on the foundation support of the static, impact, and other loads.
6. Erection drawings and procedures.
7. Single-line diagrams
8. Detailed Elementary, Schematic, Wiring, and Interconnecting Diagrams showing the arrangement, size, and location of all electrical interface points having their terminals identified and indicating the internal wiring and all control and test switch developments.
    a. There should be clear indications as to what wiring components are manufacturer supplied and what are not.
9. Common Elementary and Interconnection Wiring Diagrams are not acceptable.
10. Wire lists in lieu of wiring diagrams are not acceptable.
11. Separate customized drawings for each SWBD shall be supplied including individual point-to-point wiring diagram.
12. Complete three and two-line diagrams detailing connections for protective devices, switches, relays, meters, etc.
13. Complete Bill of Material.
14. Details of special features.
15. Instruction manuals of all protective relays for the equipment.
16. Nameplate schedules.
17. Recommended spare parts list with pricing.
18. List of Special Tools.
19. Painting Procedures.
20. List of recommended lubricants.
21. Testing Submittals
    a. Description of shop and field testing methods, procedures, and apparatus with calibration dates shall be submitted.

b. Testing methods and procedures shall be submitted at least 90 days in advance prior to conformation of witness testing dates and actual testing.

c. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 90 days in advance of actual testing. Five recent references with phone numbers shall be submitted.

22. Seismic Criteria

a. Calculations demonstrating compliance with Section 26 05 48 - Vibration and Seismic Controls for Electrical Equipment and NYCBC.

b. SWBD anchorage details with design calculations signed by NYS Licensed Engineer.

23. Operation and Maintenance Manuals

a. Preliminary Operation and Maintenance manuals.

b. Finalized Operation and Maintenance manuals.

24. Certificates of Compliance/Manufacture.

a. Provide letter signed in the presence of a notary attesting that the SWBD satisfies the requirements stated in this Section.

b. Seismic qualification certification from the manufacturer, including mounting recommendations.

c. Cybersecurity Equipment Certification

d. Data and results of witness tests shall be accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to site shall proceed.

25. Reports.

a. All certified and witnessed shop test reports

b. All field test reports.

c. All manufacturer's Site visit reports.

C. Where applicable, the Contractor is responsible to make submissions of all applicable drawings, specifications, and studies to Authorities Having Jurisdiction (AHJs) and Utilities for approvals and review.

1. Where submissions are required to be made by a Professional Engineer the Contractor shall secure these services at no additional cost to DEP.

2. These submissions for approvals and review includes those required by the NYCEC and administered by the NYCDOB and those of the Utility.

1.08 DELIVERY, STORAGE, AND HANDLING

A. SWBDs shall be delivered, stored, protected, and handled in accordance with the manufacturer's instructions, this Section, the Contract Documents, the manufacturer's instructions and the following:

1. SWBDs shall be inspected when received for shipping damage, water intrusion which may have entered the equipment during transit or loose parts, and a report of any damage made to the carrier within the specified time.
2. SWBDs shall be shipped and delivered in convenient shipping splits, each split not to exceed four (4) feet in length.
3. Each split shall be mounted on shipping skids and wrapped for protection.
4. Bus bars with associated hardware for connections between shipping groups/splits shall be shipped inside one of the splits in which it shall be installed.
5. Shipping splits shall contain accessories to permit handling by cranes.
6. SWBDs shall be stored indoors in a well-ventilated, clean, level, dry, and cool location with uniform temperature to prevent condensation.
7. SWBD equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.
8. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.
9. Embedded electronics shall be shielded from harmful electrical and magnetic energy fields.
10. SWBD equipment shall be lifted, rolled, or jacked into locations shown on the Contract Drawings.
11. Where cranes are not available, it shall be possible for splits to be skidded into final positions on rollers and using jacks to raise and lower.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts, special tools, and supplies for SWBD in accordance with the requirements of this Section and the Contract Documents.

B. The Contractor shall furnish for the SWBD, all spare parts, special tools, and supplies as recommended by the manufacturer.

C. The spare parts, special tools, and supplies shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

D. Furnish in addition the following spare parts for each SWBD:

1. One spare key shall be provided for each key interlock system.
2. One (1) set of complete replacement power fuses for each size and type installed.
3. One (1) set of complete replacement indicating lamps for each type installed.
4. One (1) set of complete replacement color caps for each type installed.
5. One (1) of each type of protection relay for each type installed.
6. One (1) spare breaker for each size and type installed.

E. Furnish the following protective equipment and tools:

1. The Contractor shall furnish one (1) set each of protective equipment and tools for each SWBD.
2. Personnel protective equipment shall conform to the requirements of the NYC DEP E&HS.
3. Personnel protective equipment required to satisfy the requirements of Section 26 05 75 – ShockHazard and Arc Flash Studies shall at the minimum consist of:
    a. Safety Goggles
    b. Face shields
    c. Protective Apron
    d. Protective Overshoes
    e. Carrying case for the above equipment
4. Furnish the following tools for each SWBD:
    a. One (1) sets of specialized wrenches and tools as required for proper installation, operation and maintenance.
    b. One (1) infrared inspection system for thermo-graphic inspection of the inter-cell cable, bus connections and terminations.
    c. One (1) cell lifting device to permit transfer of the heaviest SWBD component from the SWBD to mobile trucks or worktables.
5. Furnish the following supplies for each SWBD:
    a. The Contractor shall furnish as part of the bulk lubricant order the quantity of lubricants required to operate and maintain the SWBD equipment furnished under this section for a period of one (1) year after acceptance.
        1) Replace all lubricants used during start-up and testing prior to acceptance of equipment.

2) Furnish this replacement lubricant in addition to the lubricants included in the bulk order.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. SWBDs shall be as manufactured by:

1. Schneider Electric, Columbia, SC;
2. Siemens, Washington, DC
3. ABB, Burlington, IA;
4. Eaton Corporation;
5. Or approved equal.

B. Keys and interlock systems shall be as manufactured by:

1. Kirk, Canton OH;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Common Features

1. SWBDs shall be fully self-supporting structures with 90-inch tall vertical sections (excluding lifting eyes and pull boxes) bolted together to form the required arrangement as shown on the Contract Drawings.
2. SWBD frames shall be die formed, 12-gauge steel with reinforced corner gussets.
    a. Frame shall be rigidly bolted to support cover plates (code gauge steel), bus bars, and installed devices during shipment and installation.
3. All sections may be rolled, moved, or lifted into position.
4. SWBDs shall be capable of being bolted directly to the floor without the use of floor sills.
5. All SWBD sections shall have open bottoms and removable top plate(s) to install conduit.
6. Front-Connected SWBD sections shall be front and rear aligned for placement against a wall. Front/Rear-Access SWBDs shall be front and rear aligned.

7. All covers shall be fastened by hex head bolts.

8. Provide hinged doors over metering compartments and individually mounted device compartments.

    a. All doors shall have concealed hinges and be fastened by hex head bolts.

9. SWBD protective devices shall be furnished as listed on drawings and specified herein, including interconnections, instrumentation, and control wiring.

10. SWBDs and devices shall be rated for the voltage and frequency listed on the drawings.

11. SWBD current ratings, including all devices, shall be based on a maximum ambient temperature of 40 degrees Celsius per UL 891.

    a. With no derating required, temperature rise of SWBDs and devices shall not exceed 65 degrees Celsius in a 40 degree Celsius ambient environment.

12. SWBD Service Entrance sections shall comply with NYCEC Service Entrance requirements including a UL service entrance label, incoming line isolation barriers, and a removable neutral bond to SWBD ground for solidly grounded wye systems.

13. Group mounted feeder breaker and/or main devices within SWBDs shall be circuit breakers as indicated on the Contract Drawings.

    a. Mounting for group mounted circuit breakers shall be by bolted connections.

B. Incoming Section

1. Incoming section shall be direct cable connection to main breaker as shown on Contract Drawings.

2. Furnish SWBDs arranged for bottom entry of incoming cable.

3. Provide crimp compression type lugs in the quantity and size required as shown in Section 26 06 11 - Cable and Conduit Schedule.

    a. All lugs shall be tin-plated copper and UL listed for use with copper cable.

    b. Lugs shall be rated for 75 degrees Celsius.

4. Furnish SWBDs where indicated on the Contract Drawings with a transition section for close - coupled connection to a transformer.

C. Bus Bars

1. All phase, neutral bus bars shall be tin-plated copper.

2. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane.

3. The bus bars shall have sufficient cross sectional area to meet NYCEC requirements.
4. Phase and neutral bus ampacity shall be as shown on the plans.
5. The neutral bus shall have the same ampacity as the phase bus.
6. Bus bars shall be mounted on high impact, non-tracking insulated supports.
    a. Joints in the vertical bus are not permitted.
7. Bus bars shall be braced to withstand mechanical forces exerted during short circuit conditions as indicated in drawings, but in no case less than 65 kA RMS symmetrical.
8. Bus joints shall be bolted with high tensile steel Grade 5 bolts and Belleville type washers.
9. Ground Bus shall be sized to meet UL 891 (minimum ¼ X 2 inch) and shall the extend full length of SWBD.
10. Buses shall be arranged to be A-B-C from left to right, top to bottom, or front to rear when facing the front of the SWBD.
    a. Where special circuitry precludes this arrangement, bus bars shall be labeled.
11. All feeder device line and load terminations and extensions shall be rated to carry the current rating of the device frame.
12. The main incoming bus bars shall be rated for the main protection device frame size or main incoming conductors, if there is no main device.
13. Main horizontal bus bars shall be fully rated and arranged for future extensions.
    a. Tapered horizontal busses are not permitted.

D. Enclosure

1. SWBDs shall be NEMA 3R walk-in dead-front construction where indicated on the Contract Drawings.
2. Outdoor Enclosures
    a. SWBDS shall consist of standard cubicles with a front frame and roof assembly to provide a weather resistant structure with filtered roof vents.
    b. Space heaters shall be fed from a control power transformer in the SWBD.
    c. Front hinged doors with three-point catch with padlocking provision and wind stop.
    d. Walk-in construction shall have a minimum 48” inch wide clear walk through space.

e. Front to rear full depth lifting beams shall be provided.

f. All doors on the front of the enclosure shall be fully gasketed.

g. Space heaters shall be provided with thermostatic control.

E. Utility Metering Section

1. Provide utility metering section where indicated on the Contract Drawings.

   a. Pull section and metering compartment shall comply with the UGSs.

2. Compartment shall be barriered from the rest of the section, have a hinged lockable front cover, removable bus links with provisions for mounting current transformers, and when required, provisions for mounting voltage transformers.

   a. Current and voltage transformers shall be supplied and installed by the Electric Utility.

F. User Metering

1. User metering shall be UL listed digital multifunction power monitor.

2. The power monitor case shall be fully enclosed and shielded

3. Power monitors shall comply with the Connected Equipment, Connected Devices or Connected Devices – Meters detailed in Section 26 09 13 – Electrical Monitoring and Comunication System.

4. All instrument transformers shall be UL listed and classified as indicated in Contract Drawings.

5. Current Transformers shall be provided where shown on the Contract Drawings with burden and accuracy to support connected meters and relays as required by ANSI/IEEE C57.13.

6. Potential transformers shall be provided where shown on The Contract Drawings with burden and accuracy to support connected meters and relays as required by ANSI/IEEE C57.13.

G. SWBD Main Isolation Devices

1. The SWBD Main Isolation Device shall be an individually mounted molded case circuit breaker.

2. Tie device(s), if included, shall be the same as the main device.

3. Main and Tie Isolation Devices shall have a minimum current interrupting capacity of 65 kA symmetrical.

4. The following shall be provided with the Main Isolation Device:

   a. Auxiliary contacts

   b. Trip alarm contact

   c. Key interlocks where shown.

d. Power metering (mains only)

e. Surge Protective Devices (mains only).

H. SWBD Feeder Isolation Devices

1. Feeder Isolation Devices 800 amps and smaller shall be group mount molded-case circuit breakers with bolted connections.

2. Feeder devices larger than 800 amps shall be individually mounted molded-case circuit breakers.

3. Feeder Isolation Devices shall have a minimum current interrupting capacity of 65 kA symmetrical.

4. The following shall be provided with the Feeder Isolation Device:

a. Auxiliary contacts

I. Molded-Case Circuit Breakers

1. Group mounted breakers shall be connected to the vertical bus by bolted connections.

2. Individually mounted molded case circuit breakers shall be stationary mounted.

3. Circuit breaker frames shall be constructed of a high-strength, molded, glass-reinforced polyester case and cover.

4. Breakers shall have an overcenter, toggle handle-operated, trip free mechanism with quick make, quick break action independent of the speed of the toggle handle operation.

a. The design shall provide common tripping of all poles.

b. Breakers shall be suitable for reverse power feeds.

5. Breakers shall have ON and OFF position clearly marked on escutcheon.

a. Breakers shall include a trip-to-test means on the escutcheon for manually tripping the breaker and exercising the mechanism and trip latch.

6. Breakers shall include factory installed mechanical lugs.

a. Lugs shall be UL listed and rated 75 or 60/75 degrees Celsius as appropriate.

b. Breakers shall be 80 percent rated.

7. Breakers larger than 150 amps shall use digital true RMS sensing trip units and a rating plug to determine the breaker trip rating.

8. Each main, feeder, and tie breaker with a frame size 400 amps and larger shall have digital electronic trip units as described in this Section.

9. Circuit breakers with trip ratings greater than 250 amperes to 1200 amperes shall be UL listed as 100 percent continuous duty rated.

J. Digital Electronic Trip Unit (DETU) for Molded Case Circuit Breakers

1. Each main, feeder, and tie circuit breaker shall be equipped with a DETU.
2. The trip unit shall provide protection from overloads, short circuits and ground faults.
3. Long time and short time protective functions shall have true RMS sensing technology for harmonic rich currents including up to the 19th harmonic.
4. High contrast liquid crystal display (LCD) unit shall display settings, trip targets, and the specified metering displays.
5. A multi-button keypad shall provide local setup and readout of all trip settings on the LCD.
6. Rating Plug
   a. Shall be UL Listed and be interchangeable rating plug.
   b. It shall not be necessary to remove the trip unit to change the rating plug.
   c. Rating plugs shall be available in sizes from 40% to 100% of the breaker sensor rating.
7. The trip unit shall have an integral test jack for testing via a portable test set and connection to a battery source.
8. Noise immunity shall meet the requirements of IEEE C37.90.
9. The trip unit shall display trip targets for long time, short time, and ground fault, if included.
   a. Provide visual illuminated indication of the trip unit (normal, pickup, trip, error).
10. The trip unit shall be provided with a ten event trip real-time history log.
    a. Each trip event shall be recorded with type, phase and magnitude of fault that caused the trip
11. As a minimum, the trip unit shall have the following protective functions:
    a. Current setting or long time pickup, adjustable from 50% to 100% of the rating plug value.
    b. Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands).
       1) In addition, a set of straight line fuse shaped long time delay bands shall be provided to facilitate selectivity with downstream fuses (minimum 7 bands).

c. Instantaneous pickup, adjustable from 2.0 to 10 times the rating plug in 0.5 increments

d. Short time pickup and delay.

1) Short time pickup shall be adjustable from 1.5 to 9 times the long time pickup setting in 0.5 increments with an OFF option.

2) Provide minimum of 12 short time delay bands with three selectable I2t bands.

e. Adjustable ground fault pickup and delay. Ground fault pickup shall be adjustable from 0.4 to 1.0 times the breaker sensor rating in 0.05 increments. Provide a minimum of 15 ground fault delay bands with three selectable I2t bands. Where indicated on the drawings provide GF alarm only function which shall operate an output control contact.

12. Surge Protective Devices (SPDs)

a. Each bus of the SWBD shall be equipped with an integral SPD.

b. SPDs shall

1) Comply with Section 26 43 13 – Low-Voltage Surge Protective Devices.

2) Be fed by its own circuit breaker or disconnect.

3) Have minimum short circuit withstand rating of 100 kA per phase.

4) Be capable of displaying its status without accessing the interior of the switchgear.

13. Neutral Protection Trip

a. Trip shall provide ability to protect against neutral conductor overload.

b. Protection shall be the same as that for the phase conductors with settings at 50%, 100% or 150% of phase conductor protection settings for long time and short time pickups and delays.

c. Sensing shall be provided via a neutral current sensor or from a summation calculation using phase current sensor signals.

14. Reduced Energy Let-Through (RELT) Instantaneous trip.

a. Where shown on the Contract Drawings this feature shall be provided on individually mounted breakers to provide a temporary setting for the instantaneous trip setting of the breaker.

b. Setting shall be adjustable down to 1.5X of the rating plug and shall be enabled through a switch mounted on front of the SWBD.

c. The switch shall be combined with an indicating light that positively indicates that the RELT is enabled or disabled.

K. EMCS

1. SWBD protective, instrumentation and switching devices shall be compatible with the requirements set out in Section 26 09 13 – Electrical Monitoring and Communication System.

L. Nameplates

1. Nameplates shall clearly indicate information in accordance with NEMA and IEEE requirements.
2. Nameplates shall be engraved or embossed on stainless steel.
3. The switchgear shall have identifying nameplates in accordance with the requirements of Section 26 05 53 - Identification for Electrical Systems.
4. Nameplates shall clearly indicate information in accordance with NEMA and IEEE requirements.
5. Nameplates shall be engraved or embossed on stainless steel.
6. A master nameplate shall also be provided mounted on the assembly.
7. The master nameplate shall identify switchgear designation, voltage, ampere and short circuit rating, manufacturer’s name, general order number, and item number.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. All interior and exterior surfaces of the SWBD shall be properly cleaned and provided with a rust-inhibiting phosphatized coating
2. Steel surfaces shall have not less than two finish coats of acid resistant electrostatically applied epoxy ANSI 61 grey paint.
3. Finish coat shall be a minimum of 150 microns
4. Field painting, other that touchup painting, shall not be required.
5. A sufficient quantity of additional coating material and thinner shall be furnished to permit field touchup of damaged coatings.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Each SWBD shall be completely assembled, wired, and tested at the factory, including all buses, connections, insulators, terminals, and terminal blocks, to demonstrate that it has been properly manufactured, properly assembled, is not overheating, is not overloading, and has no electrical or mechanical defects.

2. Shop testing shall be performed on the SWBD at the manufacturer's plant prior to shipment.
3. Shop test shall be in accordance with the latest revisions of UL 891.
4. The Contractor shall provide a shop test report.
    a. The report shall identify the tests performed and the results obtained.
5. SWBD testing shall include the following:
    a. Visual and physical inspection of the interior and exterior of the SWBD including all devices to verify consistency with approved submittals.
        1) Check bus layouts and takeoffs confirm with approved submittals.
        2) Check bus for proper electrical clearances.
        3) Check tightness of all bolted and torqued connections.
        4) Verify the polarity of all instrument transformers.
        5) Verify the grounding of all instrument transformers.
        6) Verify all nameplate engravings.
    b. Mechanical operations shall be performed to ensure proper functioning of operating mechanisms and interchangeability.
    c. Continuity test shall be performed on power and control wires.
    d. Functional operations test which shall include pick up, dropout, time delay, sequence, and polarity.
    e. Primary hi-potential tests shall be performed.
        1) Primary current carrying parts shall be tested between phases, phase to ground, and line to load.
        2) The applied voltage shall be twice rated voltage plus 1000 for one minute.
    f. Hi-Potential tests on control and secondary wiring shall be performed.
        1) Control circuit wiring shall be tested for 1500 volts to ground for 1 minute.
    g. Power cables and buses shall be tested, for insulation breakdown resistance and circuit isolation.
        1) Test voltage frequency shall not be less than the frequency of the rated voltage of the equipment tested.
    h. Verify connectivity and communication of devices to be connected to the EMCS.

B. Witnessed Shop Tests:

1. The Contractor shall perform Witnessed Shop Tests in accordance with this Section and the Contract Documents.
2. The Witnessed Shop Test shall not be scheduled before the approval of the Certified Shop Tests.
3. For the Witnessed Shop Test the Contractor shall perform all of the Certified Tests in the presence of the witnesses.
4. The Contractor shall provide a Shop Test Report. The report shall identify the tests performed and the results obtained.
5. SWBD shall not be shipped before the approval of the Witnessed Shop Test Report.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine installation area to assure there is enough clearance to install SWBD.

B. Verify that installation will yield required working spaces around the SWBD installation.

C. Check concrete pads for uniformity and level surface.

D. Verify field measurements are as shown on the approved Shop Drawings.

E. Verify that required utilities are available, in proper location, and ready for use.

3.02 INSTALLATION

A. SWBD and associated equipment and accessories shall be installed in accordance with the manufacturer's instruction and recommendations.

B. SWBDs shall be bolted to the concrete bases and shall comply with seismic requirements of Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems and the NYCBC.

C. Identification

1. Identify field-installed conductors, interconnecting wiring, warning signs and components in accordance with Section 26 05 53 – Identification for Electrical Systems.
2. Label each SWBD compartment with nameplates complying with Section 26 05 53 – Identification for Electrical Systems.
3. Provide device nameplates complying with Section 26 05 53 – Identification for Electrical Systems.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. After installation, the SWBD shall be field tested for operation and conformance.
2. Field testing shall conform to the requirements in this Section, Section 01 75 10 – Preliminary and Final Field Tests, NETA ATS, and the Manufacturer's recommendations.
3. Field tests shall be witnessed by the Engineer and certified by the Contractor.
4. The services of the SWBD manufacturer shall be retained for field testing.
5. SWBD testing shall be supervised by the Manufacturer's representative, prior to energizing equipment.
6. Equipment shall not be energized without the permission of the Engineer.
7. Retain the service of an independent testing firm who shall perform field testing of the SWBD.
8. The testing firm shall have experience in the inspection and testing of SWBD equipment and shall be a member company of NETA.
    a. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

B. Preliminary Field Testing

1. Preliminary Field Test of the SWBD shall be in accordance with the recommendations of the manufacturer's representative, NETA ATS, and shall consist at a minimum of the following:
2. Visual and physical inspections shall at a minimum verify the following:
    a. Verify all SWBD equipment are located according to approved submittals.
    b. Verify all nameplates, tags and identification marks in accordance with approved submittal and preliminary As-Builts.
    c. Physical, electrical and mechanical condition shall be inspected.
    d. Proper anchorage, required area clearances, physical damage and proper alignment shall be checked.
    e. Ventilating air passageways shall be inspected for blockage.
    f. Mechanical interlock systems shall be checked for proper operation.
    g. Insulators shall be inspected for evidence of damage or contamination.
    h. Device settings and adjustments shall be verified.
    i. Breakers and vertical sections shall be checked to determine that they have been properly installed, lubricated, and connected.

j. Equipment shall be cleaned and lubricated as required.

3. Electrical testing shall at a minimum include:

a. Test continuity of all circuits

b. All connections shall be inspected for high resistance.

c. Electrical interlock systems shall be checked for proper operation.

d. Ground-resistance tests shall be performed.

e. Perform resistance measurements through bolted connections with a low-resistance measuring device.

f. Perform insulation-resistance measurements on each bus section, phase-to-phase, and phase-to-ground for one minute.

g. An over potential test shall be performed on each bus section, each phase-to-ground and on each switch in the closed position. Test each pole with other poles grounded.

h. Contact-resistance test shall be performed.

i. Control and metering wiring performance test shall be performed.

j. Primary and secondary voltage and current injections shall be performed to confirm phasing, polarities, and transformation ratios.

k. Circuit breaker trip characteristics shall be determined by primary current injection.

l. Control equipment and connections shall be checked to determine that they are not defective.

C. Preliminary Loading Tests

1. The Contractor may substitute load banks of the type and power factor which are approved by the Engineer to complete Preliminary Load Tests if the actual loads are not ready for energization.

a. The full load rating of the load bank shall be comparable to that of the circuit loads under test.

2. Preliminary Loading Tests shall at the minimum include:

a. Control voltages shall be applied and functional tests verifying the operations of all breakers, controls, and displays.

b. Primary voltage shall be applied to the complete primary bus via the SWBD main feeder breakers with tie breakers in the normal operating positions.

1) The primary buses shall remain energized for one hour with no further operations.

a) During this one hour period all voltage and potential transformer secondaries and circuits shall be

checked for voltage magnitudes, phasing, phase sequence, along with all associated metering displays.

2) After one hour, the tie breakers shall be closed, facilitating the energization of the complete bus from either main feeder for one hour.

a) During this one hour period, all voltage and potential transformer secondaries and circuits shall be checked for voltage magnitudes, phasing, phase sequence, along with all associated metering displays.

3) Each SWBD distribution feeder breaker shall be closed for one hour to energize its associated load bank.

a) During this one hour period, all metering circuits shall be checked for voltage, current, voltamp, and var values, phasing, phase sequence, along with all associated metering displays.

4) All SWBD distribution feeder breakers shall be closed for one hour to simultaneously energize all loads fed by the SWBD.

a) During this one hour period, all metering displays shall be checked.

D. Infrared testing shall be performed once after initial energization of the SWBD and a second time after full load has been applied continuously for (24) hours.

E. SWBD Final Field Test

1. SWBD Final Field Test shall be considered complete when all the outgoing circuits have energized their various loads for the Final Field Test of the respective load.

F. Any deficiencies or issues which may arise during Preliminary Field Tests, Preliminary Loading Test, or SWBD Final Field Test shall be remedied by the Contractor at no additional cost to DEP.

G. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the SWBD, check the SWBD installation before it is placed into operation and assist in the performance of Preliminary and Final Field Tests.

2. The Manufacturer’s representative shall provide SWBD equipment Start-up services and Training of the Contractor and the City’s operations and maintenance staff in the care, operation, and maintenance of the SWBD in

accordance with this Section, the Contract Documents, and the following requirements:

a. Minimum number of manufacturer's representative Site visits per SWBD:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation Supervision	2	1	2
Installation Inspection	1	1	1
Field Testing	2	1	2
Startup	2	1	2
Training	1	1	1

b. Additional trips or days that are required to achieve the proper installation, operation, or training, shall be arranged for by the Contractor at no additional cost to DEP.

c. The Engineer shall have the right to reallocate any unused time

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

b. The SWBD manufacturer's representative shall certify in writing to the Engineer that the SWBD equipment has been installed, set up, and tested properly in accordance with Contract requirements, and is operating at optimum conditions and capacity.

4. The manufacturer representative shall also make any necessary adjustments and instruct the Site personnel in its operation and maintenance.

5. The service representative shall sign in and out with the Engineer on each day they are at the Site.

6. A day shall be understood to be the actual time spent at Site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. SWBD Startup

1. SWBD Startup shall comply with the requirements of Section 01 79 05 – Equipment Start-up and Training, and shall be considered completed when all the loads on the SWBD completes their startup requirements.

B. SWBD Training

1. The Contractor shall provide Training on the SWBD in compliance with Section 01 79 05 – Equipment Start-up and Training.
2. The Contractor shall submit for approval by the Engineer lesson plans, identifying in detail, the training to be conducted.
3. The Contractor shall coordinate training services with the City and the Engineer.
4. The Contractor shall schedule training at least forty-five (45) days prior to delivery of training subject to the approval of the Engineer and the City.
5. The training shall consist of both classroom and field instruction.
6. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any control switches and other equipment required for operation; and to identify locations of any maintenance equipment.
7. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.
8. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he is at the Project.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing all new panelboards. Panelboards shall be provided in accordance with the requirements specified under this Section, , and the Contract Document.

B. Panelboards shall include all power distribution, lighting, appliance and instrument panelboards.

C. The following index of this Section is included for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 79 05 – Equipment Start-up and Training

B. Section 01 75 10 – Preliminary and Final Field Tests

C. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems

D.	Section 26 05 53	-	Identification for Electrical Systems
E.	Section 26 05 73	-	Power System Studies
F.	Section 26 05 75	-	Shock Hazard and Arc Flash Studies
G.	Section 26 43 13	-	Low-Voltage Surge Protective Devices

1.04 REFERENCES

A.	NEMA PB1	-	Panelboards
B.	NIST	-	US National Institute of Standards and Technology
C.	NYCEC	-	New York City Electrical Code
D.	NYCBC	-	New York City Building Code
E.	UL 67	-	Panelboards
F.	UL 489	-	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.05 DESCRIPTION

A. All panelboards shall be dead-front type with automatic trip-free, bolt-on, molded case circuit breakers.

B. All panelboards shall be equipped with main breakers, 1-pole, 2-pole and 3-pole branch circuit breakers as shown on the Contract Drawings.

C. All panelboards shall be enclosed in flush or surface mounted cabinets as shown on the Contract Drawings.

D. Arc Flash Labels shall be provided for all panelboards in accordance with Section 26 05 75 – Shock Hazard and Arc Flash Studies.

E. All panelboard installation shall comply with Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems and applicable seismic requirements of the NYCBC.

1.06 QUALITY ASSURANCE

A. Panelboards shall be designed, built and tested in accordance with the latest applicable standard editions of IEEE, NEMA, UL, the Utility and NYCEC.

B. The panelboard manufacturer shall be the manufacturer of all the major components of the panelboards as specified in this Section, and as per the Contract Documents..

C. All panelboards shall be new within 6 months of manufacture and complying with the requirements of this Section, the and the Contract Documents..

D. The manufacturer of the panelboard shall have produced panelboards for a minimum period of the last continuous fifteen (15) years.

E. The panelboard manufacturer shall maintain a documented Quality Assurance Program implementing suitable procedures and controls to monitor all aspects of production and testing.

1. The Quality Assurance Program shall be the manufacturer's standard program specifically dedicated to ensure that each panelboard and its components are designed, assembled and tested in accordance with the requirements specified in this Section, and the Contract Documents.

F. Panelboard shall be UL listed.

G. Whenever applicable, all Work regarding the panelboard equipment shall conform to the requirements of the Utility.

H. All cable and wire terminations at the panelboard shall be done by experienced installers who have worked with similar panelboard for a period of at least 5 years, using materials and procedures recommended by the panelboard manufacturer.

I. The Contractor shall provide list of at least five (5) installations with similar panelboard, to that which will provided under this Contract, and demonstrating compliance with these requirements.

1. The Contractor will provide the name, address, telephone number and email of the Company representative who can speak to enquires in the relation to the procurement, installation, commissioning and operation of the panelboard equipment at the above listed five installations.

J. Where [redundant]/[dual] panelboards are to be installed to confirm with Contract or Utility requirements, each panelboard shall be physically separated from other panelboards in conformity with Utility requirements and/or as shown on the Contract Drawings.

K. Seismic Requirements

1. The Contractor shall provide panelboards designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems and the NYCBC.

L. Testing

1. The panelboard manufacturer shall use a shop test facility that has calibrated testing apparatus and qualified experienced technicians for all shop tests.

2. Calibration of all testing apparatus shall be within one year.

3. Shop testing shall comply with the requirements in this Section, and the Contract Document.

4. Field testing shall comply with the requirements in this Section, and the Contract Document.

5. All test equipment, instrument calibration and test reports shall be in accordance with the latest edition of the accuracy standard of NIST and NETA ATS.

1.07 SUBMITTALS

A. Contractor shall submit shop drawings and material specifications for approval by the Engineer.

B. Submittals shall include, but not be limited to, the following:

1. Certified copy of the manufacturer's Design Tests made in accordance with UL 67and conducted on panelboard models and type that is being offered for this contract.
2. Certified dimensioned outline drawings showing panelboard layouts, front view and floor plan in sufficient detail to define space required for dismantling and maintenance, exact location of and space available for conduit entrance and the interrelationship of the various components.
3. Cross sections and details, as required, to satisfy the Engineer, that all components conform with specification requirements, including design and physical arrangement.
4. All information required by the Engineer for the design and location of all connecting structural, mechanical, or electrical items such as piping, ducts, cables, conduit, etc.
5. Weight of the panelboard and all associated equipment and distribution on the foundation support of the static, impact, and other loads.
6. Erection drawings and procedures.
7. Single-line diagrams
8. Detailed Elementary, Schematic, Wiring and Interconnecting Diagrams.
9. Common Elementary and Interconnection Wiring Diagrams are not acceptable.
10. Wire lists in lieu of wiring diagrams are not acceptable.
11. Separate customized drawings for each panelboard shall be supplied including individual point-to-point wiring diagram.
12. Complete Bill of Material.
    a. A listing of the panelboards with the number and size of circuit breakers identified.
13. Details of special features.
14. Instruction manuals of all protective devices.
15. Nameplate schedules.
16. Recommended spare parts list with pricing.
17. List of Special Tools.
18. Painting Procedures.
19. List of recommended lubricants.
20. Seismic Criteria

a. Calculations demonstrating compliance with Section 26 05 48 - Vibration and Seismic Controls for Electrical Equipment and NYCBC.

b. Panelboard anchorage details with design calculations signed by a licensed Professional Engineer, registered in the State of New York.

21. Operation and Maintenance Manuals

a. Preliminary Operation and Maintenance manuals.

b. Finalized Operation and Maintenance manuals.

22. Certificates of Compliance/Manufacture.

a. Provide letter signed in the presence of a notary attesting that the panelboard satisfies the requirements stated in this Section.

b. Seismic qualification certification from the manufacturer including mounting recommendations.

C. Where applicable the Contractor is responsible to make submissions of all applicable drawings, specifications, and studies to Authorities Having Jurisdiction (AHJs) and Utilities for approvals and review.

1. Where submissions are required to be made by a licensed Professional Engineer, the Contractor shall secure these services at no additional cost to DEP.

2. These submissions for approvals and review include those required by the NYCEC and administered by the NYCDOB and those of the Utility.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Panelboards shall be delivered, stored, protected and handled in accordance with the manufacturer’s instructions, this Section and the following:

1. Panelboards shall be inspected when received, for shipping damage, water intrusion which may have entered the equipment during transit or loose parts and a report of any damage made to the carrier within the specified time.

2. Panelboards shall be shipped and delivered in convenient packages.

3. Each package split shall be mounted on shipping skids and wrapped for protection.

4. Shipping packages shall contain accessories to permit handling by cranes.

5. Panelboards shall be stored indoors in a well-ventilated, clean, level, dry and cool location with uniform temperature to prevent condensation.

6. Panelboard equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.

7. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.
8. Embedded electronics shall be shielded from harmful electrical and magnetic energy fields.
9. Panelboard equipment shall be lifted into locations shown on the Contract Drawings.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish all spare parts, special tools and supplies for the panelboards as recommended by the manufacturer.

B. The spare parts, special tools and supplies shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. Furnish in addition the following spare parts for each panelboard installation:

1. One spare key shall be provided for each key interlock system.
2. One (1) set of complete replacement power fuses for each size and type installed.
3. One (1) spare breaker for each size and type installed.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panelboards shall be as manufactured by:

1. Schneider, Seneca, SC
2. Siemens, Washington, DC
3. ABB, Mebane, NC.
4. Eaton Corporation;
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Panelboards

1. Ratings:

a. Panelboard frequency shall be 60 Hz.

b. Panelboard ampacities, voltage, number of phases and wires shall be as shown on the Contract Drawings.

c. Panelboards shall be labeled with a UL short circuit rating. All panelboards shall be fully rated.

d. Available short circuit infeed at the panelboard shall be no more than seventy percent of the panelboard short circuit rating.

e. Panelboards rated 240VAC or less shall have a minimum short circuit rating of 22,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.

f. Panelboards rated 480VAC shall have a minimum short circuit rating of 25,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.

2. Cabinets:

a. Cabinets shall be constructed of 12-gauge galvanized steel with stainless steel hardware.

b. Cabinets shall be NEMA 12 for dry, indoor areas and NEMA 4X for corrosive areas. In hazardous locations, panelboards shall have a NEMA 7 rating.

c. Cabinets shall have wiring gutters on the sides.

d. Cabinets shall be at least 5-3/4 inches deep and 20 inches wide for panelboards with maximum branch circuit breakers of 100A. When branch circuit breakers are above 100A, cabinets shall be at least 9-1/2 inches deep and 31 inches wide.

e. Trims for panelboards shall consist of a hinged trim door which does not leave any live parts uncovered and permits the operation of all circuit breakers. In addition, a door-in-door arrangement shall form the dead front panel door covering all parts not covered by the hinged trim door. Both doors shall have concealed hinges with flush type catches and locks. All locks shall be keyed alike.

f. Cabinets shall have identifying nameplates in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems.

3. Bus Bars:

a. Bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

b. Bus bar taps for single-pole branches shall be arranged for sequence phasing of the branch circuit devices.

c. A bonded ground bus shall be included in all panels.

d. Full-size neutral bars shall be provided for panelboards, unless noted otherwise on the Contract Drawings.

e. Where specifically shown on the Contract Drawings panelboards shall be provided with a 200 percent rated neutral bus suitable for use with non-linear loads. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

4. Circuit Breakers:

a. Circuit breakers shall be the molded case type conforming to UL 489.

b. Breakers shall be the heavy-duty, bolt-on type with quick-make quick-break toggle mechanism for manual as well as automatic operation.

c. Breakers shall have 100-amp frames, with 15-amp trip elements as minimum, unless otherwise shown on the Contract Drawings.

d. All 100-amp frame breakers shall be fixed thermal magnetic trip units.

e. Frame sizes above 100 amp shall have interchangeable thermal magnetic trip units or electronic trip units.

f. Where specifically shown on the Contract Drawings breakers shall be provided with electronic trip units. Electronic trip units shall provide long time, short time, instantaneous and ground fault settings and time adjustments as a minimum.

g. Where specifically shown on the Contract Drawings ground fault circuit interrupters shall be provided. Ground fault breakers shall be equipped with solid state sensing and 5 milliamp sensitivity.

h. Breakers used for lighting circuit switching shall be suitable for the purpose and shall be marked "SWD". Breakers requiring continuous operation shall be provided with a lock-on device.

i. Where specifically shown on the Contract Drawings shunt trips, bell alarms, and auxiliary devices shall be provided.

5. Metering:

a. Where shown on the Contract Drawings a UL listed microprocessor metering unit (MU) shall be installed in the panelboard.

b. The MU shall have the capability to monitor all the panelboard outgoing and spare circuits including capacity for an additional twenty percent spare circuits.

c. The MU shall be able to monitor and time stamp at a minimum the following per phase and line values for each circuit:

1) Voltage, Current, Power, Power Factor, VAR and Frequency.

2) Watt Hour and Var Hour both forward and reverse.

d. The MU shall be able to auto-detect sensor rating

e. The MU shall store the energy profile for each circuit in a non-volatile memory for a minimum of one year. The demand interval shall be 15 minutes.

f. MU communications ports and protocols shall be consistent with those adopted for the site or facility and shall be as stated in the Specifications or as shown on the Contract Drawings.

6. Surge Protection:

a. The panelboard shall be provided with surge protective devices complying with Section 26 43 13 – Low-voltage Surge Protective Devices.

7. Directories:

a. Each panel shall be provided with a directory.

b. The directory shall be protected by a glass or noncombustible plastic cover.

c. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service and the number of spares.

1) This directory shall be updated as work progresses, and final, typewritten directories shall be provided at the end of the Contract.

d. Where execution of the work under this Contract requires certain circuits to be modified, the Contractor shall update or provide panelboard directories to reflect the modifications.

1) Final typewritten directories shall be provided at the end of the Contract.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one coat of zinc chromate primer.

2. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose enamel lacquer.

3. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI No. 61.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Each panelboard shall be completely assembled, wired and tested at the factory, including all buses, connections, insulator, terminals and terminal blocks, to demonstrate that it has been properly manufactured, properly assembled, is not overheating, is not overloading and has no electrical or mechanical defects.
2. Shop testing shall be performed on the panelboard at the manufacturer's plant prior to shipment.
3. Shop test shall be in accordance with the latest revisions of UL, IEEE and ANSI and shall demonstrate that the equipment tested conforms to the requirements specified.
4. The Contractor shall provide a Certified Shop Test Report.
    a. The report shall identify the tests performed and the results obtained.
5. Panelboard shop tests shall include the following:
    a. Visual and physical inspection of the interior and exterior of the panelboard including all devices to verify consistency with approved submittals.
        1) Check bus layouts, breaker types, sizes and quantities confirm with approved submittals.
        2) Check bus for proper electrical clearances.
        3) Check tightness of all bolted and torqued connections.
        4) Verify all grounding provisions.
        5) Verify all nameplate engravings.
    b. Mechanical operations shall be performed to insure proper functioning of operating mechanisms and interchangeability.
    c. Continuity test shall be performed on power and control wires.
    d. Functional operations test which shall include pick up, dropout, time delay, sequence and polarity.
    e. Primary hi-potential tests shall be performed.
        1) Primary current carrying parts shall be tested between phases, phase to ground, and line to load.
        2) The applied voltage shall be twice rated voltage plus 1000 for 1 minute, 1500 volts minimum.
    f. Verify connectivity and communication of devices to be connected to the EMCS.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine installation area to assure there is enough clearance to install panelboard.

B. Verify that installation will yield required working spaces around the panelboard installation.

C. Check installation surfaces for uniformity and level surface.

D. Verify field measurements are as shown on the approved Shop Drawings.

E. Verify that required utilities are available, conduit runs etc. are in required location and ready for use.

3.02 INSTALLATION

A. Panelboards shall be mounted rigidly and securely to the building structure or to supporting devices which are rigidly and securely supported by the building structure.

B. Anchor panelboards in accordance with Section 26 05 48 – Vibration and Seismic Controls for Electrical Equipment and the NYCBC.

C. Panelboards shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on metal.

D. Mount all panelboards parallel or perpendicular to walls, such that panelboards are installed in a neat and professional manner.

E. All wiring shall be neat within the panelboards. Wires shall be run vertically in the wire gutter and then terminate horizontally at a breaker.

F. The Contractor shall install blanking devices within panelboard spaces, so bus bars are not exposed.

G. Install panelboard nameplates for identification of equipment.

H. Panelboard circuits shall be installed so to balance the loads on each of the panelboards.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. After installation, the panelboard shall be field tested for operation and conformance.

2. Field testing shall conform to the requirements in this Section, Section 01 75 10 – Preliminary and Final Field Tests, NETA ATS and the Manufacturer’s recommendations.

3. Field tests shall be certified by the Contractor.

4. Equipment shall not be energized without the permission of the Engineer.

B. Preliminary Field Testing

1. Preliminary field test of the panelboard shall be in accordance with the recommendations of the manufacturer, NETA ATS and shall consist at a minimum of the following:
2. Visual and physical inspections shall at a minimum verify the following:
    a. Verify all panelboard equipment are located according to approved submittals.
    b. Verify all directories, nameplates, tags and identification marks in accordance with approved submittal and preliminary As-Builts.
    c. Physical, electrical and mechanical condition shall be inspected.
    d. Proper anchorage, required area clearances, physical damage and proper alignment shall be checked.
    e. [Ventilating air passageways shall be inspected for blockage.]
    f. Mechanical interlock systems shall be checked for proper operation.
    g. Insulators shall be inspected for evidence of damage or contamination.
    h. Breaker settings and adjustments shall be verified.
    i. Breakers and vertical sections shall be checked to determine that they have been properly installed, and connected.
    j. Equipment shall be cleaned as required.
3. Electrical testing shall at a minimum include:
    a. Test continuity of all outgoing circuits.
    b. All connections shall be inspected for high resistance.
    c. Electrical interlock systems shall be checked for proper operation.
    d. Ground-resistance tests shall be performed.
    e. Perform resistance measurements through bolted connections with a low-resistance measuring device.
    f. Perform insulation-resistance measurements on each bus, phase-to-phase, and phase-to-ground for one minute.
    g. An over potential test shall be performed on each bus, each phase-to-ground and on each switch in the closed position. Test each pole with other poles grounded.
    h. Control and metering wiring performance test shall be performed.
    i. [Circuit breaker trip characteristics shall be determined by primary current injection.]
    j. Control equipment and connections shall be checked to determine that they are not defective.

C. Preliminary Loading Tests

1. The Contractor may substitute load banks of the type and power factor which are approved by the Engineer to complete preliminary load tests if the actual loads are not ready for energization.
    a. The full load rating of the load bank shall be comparable to that of the circuit loads under test.
2. Preliminary loading tests shall at the minimum include:
    a. Primary voltage shall be applied to the complete primary bus via the panelboard main breakers.
        1) The primary bus shall remain energized for [one hour] with no further operations.
            a) During this [one hour] period all voltage circuits shall be checked for voltage magnitudes, phasing, phase sequence along with any associated metering displays.
        2) Each panelboard circuit breaker shall be closed for [one hour] to energize its associated [load]/[load bank]/[feeder].
            a) During this [one hour] period all circuits shall be checked for voltage, current, voltamp, and var values, phasing, phase sequence along with any associated metering displays.
        3) All panelboard circuit breakers shall be closed for [one hour] to simultaneously energize all loads fed by the panelboard.
            a) During this [one hour] period all metering displays shall be checked.

D. Infrared testing shall be performed once after initial energization of the panelboard and a second time after full load has been applied continuously for (24) hours.

E. Panel Final Field Test

1. Panel final field test shall be considered complete when all the outgoing circuits shall have energized their various loads for the Final Field Test of the respective load.

F. Any deficiencies or issues which may arise during preliminary field tests, preliminary loading tests or panelboard final field tests shall be remedied by the Contractor at no additional cost to DEP.

3.04 STARTUP / DEMONSTRATION

A. Panelboard Startup

1. Panelboard startup shall comply with the requirements of Section 01 79 05 – Startup and Training and shall be considered completed when all the circuit loads on the panelboard completes their startup requirements.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 24 19 – MOTOR CONTROL CENTERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing new Motor Control Centers (MCCs). New MCCs shall be provided in accordance with the requirements specified under this Section and the Contract Document.

B. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install MCCs completely and operationally.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	8
1.10	Warranty	9
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	11
2.03	Fabrication / Assembling / Finishes	11
2.04	Source Quality Control / Shop Tests	21
PART 3	EXECUTION	23
3.01	Examination / Preparation	23
3.02	Installation	23
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	28
3.05	Adjusting / Protection / Cleanup	29

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 15 - Witness Shop Testing.

B. Section 01 79 05 – Equipment Start-up and Training

C. Section 01 75 10 – Preliminary and Final Field Tests
D. Section 09 91 00 - Painting
E. Section 26 05 11 - General Electrical Requirements
F. Section 26 05 27 - Grounding
G. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems
H. Section 26 05 53 - Identification for Electrical Systems
I. Section 26 05 75 - ShockHazard and Arc Flash Studies
J. Section 26 08 11 - General Electrical Testing
K. Section 26 29 13 - Enclosed Controllers
L. Section 26 43 13 - Low-Voltage Surge Protective Devices

1.04 REFERENCES

A. Definitions

1. Low-Voltage as used in this Section and the Specifications shall mean all equipment, conductors, insulation systems, and accessories intended for operation at less than 1000 VAC and within the 600 VAC Class.

B. Reference Standards

1.	NEMA ICS 1	-	Industrial Control Systems: General Requirements
2.	NEMA ICS 2	-	Industrial Control and Systems: Contactors and Overload Relays Rated 600V
3.	NEMA ICS 2.3	-	Instruction for Handling, Installation, Operation and Maintenance of Motor Control Centers Rated Not More Than 600V
4.	NEMA ICS 18	-	Motor Control Centers
5.	NEMA 250	-	Enclosures for Electrical Equipment (1000V maximum).
6.	NYCBC	-	New York City Building Code
7.	NYCEC	-	New York City Electrical Code
8.	NETA ATS	-	NETA Acceptance Testing Specifications.
9.	NFPA 70E	-	Standard for Electrical Safety in the Workplace.
10.	NFPA 79	-	Electrical Standard for Industrial Machinery
11.	UL 489	-	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
12.	UL 845	-	Motor Control Centers.

1.05 DESCRIPTION

A. Ratings

1. MCCs shall be low-voltage Class suitable for operation on a three-phase, 60 hertz system.

2. The nominal operating voltage, number of wires, bus ampacity, and short circuit withstand capability shall be as shown on the Contract Drawings.

3. The incoming disconnect device of each unit compartment incoming circuit shall have a minimum short circuit interrupting rating of 65 kA symmetrical.

4. MCC wiring shall be rated NEMA Class II, Type B.

5. All motor starters shall be NEMA size 1 minimum.

1.06 QUALITY ASSURANCE

A. MCCs shall be designed, built, and tested in accordance with the requirements of IEEE, NEMA, UL, the Utility, and the NYCEC.

B. The MCC manufacturer shall be the manufacturer of all the major components of the MCC, as specified in this Section and per the Contract Documents.

C. All MCCs shall be new within six months of manufacture and comply with the requirements of this Section and the Contract Documents.

1. All structures shall be fabricated of code gauge steel.

2. The Contractor shall obtain motor nameplate data on the actual equipment that will be powered by the MCC to properly size circuit breakers, starters, and overloads.

3. The settings of all devices shall be based upon the actual motors or loads furnished.

4. When shown on the drawings, MCCs shall be constructed as service equipment in accordance with the requirements of the NYCEC.

D. The MCC manufacturer shall have been engaged in the production, installation, and providing of field service on MCC for a minimum of 15 years.

E. The MCC manufacturer shall maintain a documented Quality Assurance Program implementing suitable procedures and controls to monitor all aspects of production and testing.

1. The Quality Assurance Program shall be the manufacturer’s standard program specifically dedicated to ensure that each MCC and its components are designed, assembled, and tested in accordance with the requirements specified in this Section and the Contract Documents.

F. Whenever applicable, all Work regarding the MCC shall conform to the requirements of the Utility.

1. All cable and wire terminations at the MCC shall be done by experienced installers who have worked with similar MCCs for a period of at least five years, using materials and procedures recommended by the MCC manufacturer.

G. The Contractor shall retain the services of the MCC manufacturer's representative to certify that the MCC installation is in accordance with the manufacturer's requirements.

H. Seismic Requirements

1. The Contractor shall provide MCCs which are designed, constructed, and installed suitably for earthquake regulations in accordance with the requirements of Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems and the NYCBC.

I. Testing:

1. The MCCs shall be shop tested, inspected, witnessed shop tested, and field tested in accordance with this Section, the Specifications, and the MCC manufacturer’s procedures.

2. The MCC manufacturer shall use a shop test facility that has a recently calibrated testing apparatus and qualified, experienced technicians, for all Shop and Field Tests.

3. Calibration of testing apparatus shall be within one year.

4. Shop testing shall comply with the requirements in this Section, the Specifications, and the Contract Drawings.

5. Field testing shall comply with the requirements in this Section, the Specifications, and the Contract Drawings.

6. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. NIST and NETA ATS.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for approval by the Engineer.

B. Submittals shall include, but not be limited to:

1. Certified copy of the manufacturer’s Design Tests made in accordance with UL 845 and conducted on MCC models and type that is being offered for this Contract.

2. Certified dimensioned outline drawings showing equipment layouts, front views, and floor plans in sufficient detail to define the space required for dismantling and maintenance and the exact location of and space available for conduit entrance and the interrelationship of the various components.

3. Cross sections and details, as required, to satisfy the Engineer, that all components conform with specification requirements, including design and physical arrangement.

4. All information required by the Engineer for the design and location of all connecting structural, mechanical, or electrical items such as, ducts, cables, conduits, etc.
5. Weight of the MCC and all associated equipment and distribution on the foundation support of the static, impact, and other loads.
6. Erection drawings and procedures.
7. Single-line diagrams.
8. Detailed Elementary, Schematic, Wiring, and Interconnecting Diagrams showing the arrangement, size, and location of all electrical interface points with their terminals identified and indicating the internal wiring and all control and test switch developments of each compartment.
    a. There should clear indications as to which wiring components are manufacturer-supplied and which are not.
    b. Unit control schematics and wiring diagrams showing numbered terminal points and all interconnections.
    c. A separate diagram shall be provided for each compartment.
    d. The diagram shall also include the equipment name, number, and the MCC designation.
9. Common Elementary and Interconnection Wiring Diagrams are not acceptable.
10. Wire lists in lieu of wiring diagrams are not acceptable.
11. Separate customized drawings for each MCC shall be supplied including individual point-to-point wiring diagram.
12. Complete three and two-line diagrams detailing connections for protective devices, switches, relays, meters, etc.
13. Complete Bill of Material.
    a. A completed materials list with outline and summary sheets and schedule of equipment in each unit compartment.
14. Details of special features.
15. Instruction manuals of all protective relays for the equipment.
16. Nameplate schedules.
17. Recommended spare parts list with pricing.
18. List of Special Tools.
19. Painting Procedures.
20. List of recommended lubricants.
21. Testing Submittals

a. Description of shop and field-testing methods and procedures and an apparatus with calibration dates shall be submitted.

b. Testing methods and procedures shall be submitted at least 90 days in advance prior to conformation of witness testing dates and actual testing.

c. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 90 days in advance of actual testing. Five recent references with phone numbers shall be submitted.

22. Seismic Criteria

a. Calculations demonstrating compliance with Section 26 05 48 - Vibration and Seismic Controls for Electrical Equipment and NYCBC.

b. MCC anchorage details with design calculations signed by NYS Licensed Engineer.

23. Operation and Maintenance Manuals

a. Preliminary Operation and Maintenance manuals.

b. Finalized Operation and Maintenance manuals.

24. Certificates of Compliance/Manufacture.

a. Provide letter signed in the presence of a notary attesting that the MCC satisfies the requirements stated in this Section.

b. Seismic qualification certification from the manufacturer including mounting recommendations.

c. Cybersecurity Equipment Certification

d. Data and results of witness tests shall be accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to Site shall proceed.

25. Reports.

a. All certified and witnessed shop test reports.

b. All field test reports.

c. All manufacturer's Site visit reports.

26. Mimic Diagrams

a. Mimic Diagrams submittals shall be a two-step process.

1) An initial submission describing the proposed graphic submission fully including the colors, line sizes, and all features. This submittal will be subject to change and approval.

2) A second on final submission incorporating all approved elements of the first submission. The final submission shall accompany all initial and revised MCC submittals.

C. Where applicable, the Contractor is responsible to make submissions of all applicable drawings, specifications, and studies to Authorities Having Jurisdiction (AHJs) and Utilities for approvals and review.

1. Where submissions are required to be made by a Professional Engineer, the Contractor shall secure these services at no additional cost to DEP.

2. These submissions for approvals and review include those required by the NYCEC and administered by the NYCDOB and those of the Utility.

3. The costs of the drawing submission and any resubmissions shall be included in the lump sum price bid for the Work under this Contract.

1.08 DELIVERY, STORAGE, AND HANDLING

A. MCCs shall be delivered, stored, protected, and handled in accordance with this Section, the Contract Documents, the manufacturer's instructions, and the following:

1. MCCs shall be inspected when received for shipping damage, water intrusion which may have entered the equipment during transit, or loose parts, and a report of any damage shall be made to the carrier within the specified time.

2. MCC shall be shipped and delivered in convenient shipping splits, each split not to exceed two feet in length.

3. Each split shall be mounted on shipping skids and wrapped for protection.

4. Bus bars along with associated hardware for connections between shipping groups/splits shall be shipped inside the splits in which it shall be installed.

5. Shipping splits shall contain accessories to permit handling by cranes.

6. MCC equipment shall be stored indoors in a clean, dry, and cool location in which a uniform temperature is maintained.

7. MCC equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.

8. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.

9. Embedded electronics shall be shielded from harmful electrical and magnetic energy fields.

10. MCCs shall be lifted, rolled, or jacked into locations shown on the Contract Drawings.

11. MCC shall be handled and placed in final positions without all withdrawable components such as circuit breakers.

12. Where cranes are not available, it shall be possible for splits to be skidded into final positions on rollers and jacks to be used for raising and lowering.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts, special tools, and supplies for the MCCs in accordance with this Section and the Contract Documents.

B. The Contractor shall furnish all spare parts, special tools, and supplies as recommended by the MCC manufacturer.

C. The spare parts and special tools shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

D. Furnish in addition to the following spare parts for each MCC:

1. One starter, one circuit breaker, and one MCP for each of six starters, circuit breakers, and MCPs of a type and size used, but not less than a minimum of one spare starter, one circuit breaker, and one MCP shall be provided.

2. Twelve fuses, for each type and size used.

3. Four control relays and timers for each type and size used.

4. One control power transformer for each type and size used.

5. Five indicating lamp assemblies with lamps for each type and size used.

6. Two additional interlock system keys.

E. Furnish the following protective equipment and tools:

1. The Contractor shall furnish one (1) set each of protective equipment and tools for each MCC.

2. Personnel protective equipment shall confirm to the requirements of the NYC DEP E&HS.

3. Personnel protective equipment required to satisfy the requirements of Section 26 05 75 - ShockHazard and Arc Flash Studies shall at the minimum consist of:

a. Safety Goggles

b. Face shields

c. Protective Apron

d. Protective Overshoes

e. Carrying case for the above equipment

4. Three 25 ft. ground cable sets for use with the ball studs specified in this Section.

F. Furnish the following special tools for each MCC installation:

1. One set of tools recommended by the manufacturer.

2. One portable infrared and contact thermometer capable of taking readings via the inspection windows provided in the MCC.

3. One portable hoist to load and unload equipment from the MCC unit compartments onto a mobile work table.

   a. Minimum capacity shall be one ton.

4. One mobile work table capable of moving MCC equipment to and away from the MCC and in and out of the MCC location.

   a. The work table shall consist of two shelves.

   b. Minimum capacity shall be one ton.

   c. Minimum size of the work table shall be 24” L x24” W x 36” H.

G. Furnish the following supplies for each MCC:

1. The Contractor shall furnish as part of the bulk lubricant order the quantity of lubricants required to operate and maintain the MCC equipment furnished under this section for a period of one (1) year after acceptance.

   a. Replace all lubricants used during start-up and testing prior to acceptance of equipment.

   b. Furnish this replacement lubricant in addition to the lubricants included in the bulk order.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. MCCs shall be as manufactured by:

1. Schneider Electric, Senaca, SC;

2. Siemens, Washington, DC

3. Eaton Corporation;

4. ABB, Mebane, NC;

5. Or approved equal.

B. Low voltage power circuit breakers shall be as manufactured by:

1. Schneider Electric, Columbia, SC;

2. Siemens, Washington, DC

3. ABB, Burlington, IA;

4. Eaton Corporation;
5. Or approved equal.

C. Molded-case circuit breakers shall be as manufactured by:
1. Schneider Electric, Columbia, SC;
2. Siemens, Washington, DC
3. ABB, Burlington, IA;
4. Eaton Corporation;
5. Or approved equal.

D. Low-voltage Surge Protective Devices shall be as manufactured by:
1. Square D/Schneider Electric.
2. ABB, Burlington, IA;
3. Eaton Corporation;
4. Or approved equal.

E. Key interlock systems shall be as manufactured by
1. Kirk, North Canton, OH.
2. Or approved equal.

F. Ball grounding studs and covers shall be as manufactured by:
1. AB Chance, Centralla, MO.
2. Or approved equal.

G. Ground cable set for use with ball studs shall be as manufactured by:
1. AB Chance, Centralla, MO.
2. Or approved equal.

H. Infrared thermometers shall be as manufactured by
1. Fluke Phoenix, AR.
2. Or approved equal.

I. Infrared monitoring windows shall be as manufactured by
1. Fluke Phoenix, AR.
2. Or approved equal.

J. Portable Hoists shall be as manufactured by:
1. Columbus McKinnon, Getzville, NY.
2. Or approved equal.

K. Work tables shall be as manufactured by:
1. Jamco Products, South Beloit, IL.

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Wiring

1. Control and power wiring shall be MTW type, flame-retardant to VW-1, moisture, heat and oil-resistant thermoplastic insulation rated 600-volt, 90 degrees Celsius, with stranded copper conductors.
2. Control wires shall be colored red.
3. Power phase wires shall be colored black with neutral wires white.
4. Ground wires shall be colored green.
5. Control wire size shall be No.14 AWG minimum.
6. Power wire size shall be No.12 AWG minimum.
7. All wiring shall be labeled in accordance with the wiring numbers shown in the wiring diagrams. Wire numbers shall not repeat.

B. Surge Protective Devices

1. Each bus of the MCC shall be equipped with an integral surge protective device (SPD).
2. It shall be possible to view the state of all the SPD functions without having to access the interior of the MCC.
3. Surge Protective Devices shall:
   a. Comply with Section 26 43 13 - Low-Voltage Surge Protective Devices.
   b. Be fed by its own circuit breaker.
   c. Have a short circuit withstand rating 200,000 amps per phase.
   d. Have LEDs for status indication of protection modules.
   e. Contain a surge counter.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Arrangement

1. MCC main busses shall be configured in main-tie-tie-main arrangement, with each bus fed by a main breaker and the two busses connected by a tie breaker.
2. Main and tie breakers shall interlocked.
3. Interlocking shall be as shown on the Contract Drawings.

B. Structure

1. The structure enclosures shall be NEMA Type 12 dust-tight and drip-proof.

2. Structures shall be totally enclosed dead front, freestanding, front accessible assemblies comprised of vertical sections of heavy gauge steel bolted together forming a rigid assembly. Each vertical section shall be in accordance with the following:

   a. Sections shall be 90 inches high (not including base channel or lifting angle) and minimum of 20 inches wide. Minimum depth shall be 20 inches. Larger widths or depths shall be utilized as required or as shown on the Contract Drawings.

   b. Each vertical section shall contain a top and bottom horizontal wireway for incoming lines and wiring between sections.

   c. A vertical wireway shall be located to the right side of each vertical section. The vertical wireway shall be covered by a hinged door.

   d. Vertical wireways shall contain cable tie supports. Each individual device compartment shall have a side barrier to permit pulling wire from vertical wireway without disturbing adjacent device compartments.

   e. Removable lifting angles or tabs shall be mounted on top of each section.

   f. Removable bottom channel sills shall be mounted front and rear of vertical section and shall extend full width of line-up.

3. Compartments for mounting units shall be incrementally arranged such that not more than six NEMA Size 1 starters are mounted within any vertical section. Guide rails shall be provided.

4. Construction for mounting units shall be back-to-back. Back-to-back construction shall permit the mounting of units within the front and rear of a single section.

5. MCCs shall have an inspection window for infrared inspections.

C. I/O Compartments

1. Where shown on the Contract Drawings, MCCs shall be provided with empty vertical sections approximately 90 inches high by 30 inches wide and 20 inches deep at each end of the MCC lineup to house equipment provided by I/O Suppliers or to marshal control signals going out to the field.

2. The interior of the I/O compartments and sub-panels shall be painted in accordance with this Section.

3. All required status and command terminal points within the MCC shall be wired to terminal blocks conforming to this Section and located in the lower compartments of these vertical sections.

4. The I/O suppliers includes any vendor whose equipment are required to interface with MCC equipment and are shown installed in the MCCs.

5. The I/O supplier(s) shall mount his equipment on a subpanel constructed to meet the requirements of the MCC manufacturer as follows:

   a. The MCC end sections shall accept two subpanels split vertically, 2/3 for the top section and 1/3 for the bottom section.

   b. The bottom section shall be provided by the Electrical Contractor and shall contain master terminal blocks.

   c. All MCC I/O associated with the PMCS shall be wired to these master terminal blocks by the Electrical Contractor.

   d. The upper subpanel shall be provided under this I/O Suppler and contain a combination of communication equipment, PLCs, I/O and PMCS terminal blocks as shown on the Contract Drawings.

   e. Connections between the terminal blocks on upper and lower subpanels shall be provided by the Electrical Contractor.

   f. Under the direct supervision of the I/O supplier(s), the I/O subpanel assemblies shall be installed in the MCCs and terminal to terminal wiring installed by the Electrical Contractor.

   g. The Electrical Contractor shall furnish, install, test all wiring between the individual MCC compartments control signals and the master terminal block located on the MCC I/O subpanels in the lower part of the MCC I/O sections.

   h. The Electrical Contractor shall furnish, install and test all wiring between the I/O subpanels prewired terminals and the MCC I/O master terminal blocks.

   i. Typical MCC I/O shall be provided for all spare and future MCC compartments with an additional twenty percent (20%) of each type of I/O provided as spare.

   j. All MCC I/O including spare and future, shall be wired to the fixed type master terminal blocks provided under Electrical Contract and identified.

D. Bus Layout

1. MCC shall contain main horizontal and vertical tin-plated copper busses.

2. Main horizontal bus shall be isolated from wire ways, starters, and other areas by insulated barriers. Bus bars shall be supported on polyester reinforced insulators.

3. Vertical busses feeding unit compartments shall be 800 ampere minimum, except in main and tie breaker sections which shall be 2000 amperes, as required by NYCEC. Vertical bussing shall be securely bolted to the horizontal main bus. All joints shall be front-accessible for ease of maintenance. Two independent front and rear vertical buses shall be provided within each section arranged for back-to-back construction.

4. Vertical busses shall be completely isolated and insulated. Small openings in bus sandwich shall permit unit stabs to plug into vertical bus bars, rather than onto them. Shutter mechanism shall be furnished to completely isolate vertical bus, including stab area opening, when plug-in device is removed.

5. Neutral buses shall be tin-plated copper and extend the entire length of the equipment, where applicable. The neutral bus shall have a capacity equal to one half the capacity of the main power bus.

6. MCC shall contain a tin-plated copper horizontal ground bus which extends the full width of the structure. The horizontal ground bus shall be rated 300 ampere. Pressure type ground lugs shall be mounted on the ground bus in the incoming line sections.

7. A vertical plug-in ground bus shall be tin-plated copper and linked to the horizontal ground bus. The vertical ground bus shall be rated 300 ampere. This tin-plated copper vertical plug-in grounding bus, in combination with the unit ground bus stab, shall establish unit insert grounding before the plug-in power stabs engage the power bus, and conversely, as the unit is withdrawn, grounding is maintained until after the plug-in power stabs are disengaged.

E. Unit Compartments

1. Unit compartments shall contain circuit breakers, combination motor starters, and related control equipment as required and shown on the Contract Drawings.

2. Each unit compartment shall be provided with an individual front door.

3. Each unit compartment door shall have a drawing holder mounted on the inside of the door for holding wiring diagrams of that compartment only.

4. Plug-in units shall be supported and guided by a removable support pan, so that unit rearrangement is easily accomplished.

5. The rearrangement of the unit support pan from one location to the other shall be accomplished without use of tools. After insertion, each plug-in unit shall be held in place by at least two multi-turn latches, located on the front of the unit. At least one latch shall be located at the top of the unit and one at the bottom, for front accessibility and inspection convenience.

6. All units shall be isolated from one another, above and below, by unit support pans or steel barriers which can remain in place when the units are withdrawn.

7. Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers.

8. All spare compartments shall be fully equipped with mounting rails and accessories and all miscellaneous hardware. Spare starters shall also include terminal blocks and pilot devices in accordance with starter types shown on the Contract Drawings.

9. All space compartments shall be fully equipped with mounting rails and accessories and all miscellaneous hardware required for the future installation of a breaker or starter.

10. Empty compartments shall be provided as shown on the Contract Drawings.

11. Operating Mechanisms

    a. An operating mechanism shall be mounted on the primary disconnect of each feeder or starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock.

    b. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or re-insertion of the unit while in the ON position.

    c. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with one to three padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

    d. Maximum height for all disconnect devices shall be not more than six feet and six inches from the finished floor to midpoint of the disconnect device handle and its highest operating point.

12. Main and Tie Breakers Compartments/Sections

    a. The incoming line lug compartments shall be equipped with terminal lugs suitable for terminating the cables shown on the Contract Drawings.

    b. The main incoming circuit breakers and tie breaker shall be low-voltage power circuit breaker or molded case drawout type.

    c. The power circuit breakers shall have the following features:

        1) Can be charged, open, and closed electrically as well as manually.

        2) Equipped with a true, two-step stored energy mechanism with a maximum five-cycle closing.

        3) Equipped with a solid-state tripping system consisting of three (3) current sensors, microprocessor-based trip device, and low energy trip actuator. The tripping system shall at a minimum allow for the adjustment of the following functions:

            a) Long-time pick-up and delay

            b) Short-time pick-up and delay

            c) Ground fault pick-up and delay

d) Instantaneous pick-up

e) Zone interlocking to facilitate delayed trip action.

f) Zone interlocking shall be as shown on the Contract Drawings

4) Breaker status indicators for the following:

a) Operations counter

b) red for ‘CLOSE’,

c) green for ‘OPEN’,

5) The Trip Unit shall have an information system that uses battery back-up LED to indicate mode of operation following an automatic trip operation.

d. Trip units for the main and tie breakers shall have an instantaneous override.

e. Molded case circuits breakers shall conform to the requirements for Feeder Breakers specified in this Section.

13. Feeder Breakers

a. Feeder circuit breakers shall be the molded case type.

b. Feeder circuit breakers shall have operating mechanisms as described in Unit Compartments above.

c. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.

d. Breakers shall be manually operated and shall provide thermal magnetic, inverse-time overload, and instantaneous short-circuit protection. Provide electric trip units where shown.

e. Breakers shall have 100A frames as a minimum.

f. Overload protection shall be provided on all poles, with trip settings as indicated on the Contract Drawings.

g. Where shown on the Contract Drawings, feeder breakers shall have internal or external auxiliary devices capable of monitoring and transmitting electrical quantities to remote locations.

h. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of arc chutes.

i. Circuit breakers with trip ratings of 100 amperes and higher shall have electronic RMS sensing trip units, which shall be self-contained with all necessary components including three current sensors and flux transfer shunt trip.

j. The trip unit shall have the following features:

1) Long-time pick-up and delay

2) Short-time pick-up and delay

3) Ground fault pick-up and delay

4) Instantaneous pick-up

5) Zone interlocking to facilitate delayed trip action.

6) Zone interlocking shall be as shown on the Contract Drawings

k. Rating plugs shall be interlocked so they are not interchangeable between frames and interlocked so that a breaker cannot be closed and latched with the rating plug removed. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a 120-volt operated test set. Provide one test set capable of testing all breakers 100 ampere frame and above. A status LED indicating light shall be provided.

14. Combination Motor Control Units:

a. Combination motor control units shall consist of a main disconnect device, a motor starter, and auxiliary control devices as required and shown on the Contract Drawings.

b. Disconnect Device

1) The disconnect device shall be a circuit breaker or motor circuit protector type. The motor circuit protector shall be molded case device with a magnetic current sensing coil in each of the three poles. The current sensing coil shall have an adjustable trip setting by means of a single dial, mounted on the front of the breaker.

2) Where required to meet the interrupting ratings shown on the Contract Drawings, the circuit breaker design shall include a current limiting feature for proper performance of the circuit breaker and motor starter in combination during short circuit conditions.

c. Motor Starters

1) General

a) Motor starters shall be electrically operated, electrically held, three-pole solid state contactors with arc extinguishing characteristics and silver-to-silver renewable contacts.

b) Starters shall have provisions for a minimum of four normally open and four normally closed auxiliary contacts.

c) Starters shall be full voltage non-reversing or reversing single and multispeed types as shown on the Contract Drawings.

d) Starters shall be equipped with extra contactors and interlocking contacts as required and shown on the Contract Drawings.

2) Protection and Overloads

a) Motor starters shall be provided with ground fault protection.

b) Ground fault protection shall be set at 20 percent of maximum continuous ampere rating and have a start delay of 20 second and run delay of one (1) second to prevent nuisance trip on.

c) Motor starters shall be provided with solid state overload relays with provisions for ambient temperature compensation and discrete sensing for each ungrounded phase. The setting of the overload relays shall be manually adjustable through a range of 85 to 115 percent of the normal trip rating.

d) The overload relays shall be equipped with a reset. The reset shall be mounted on the starter compartment door and shall allow manual reset without opening the compartment door. The relays shall include isolated dry contacts, one normally open and one normally closed, to signal an overload trip condition.

3) Control Power Transformers

a) Control power transformers shall be provided with each combination motor control unit. Control power transformers shall have 120-volt secondaries and shall have the following minimum volt-amp ratings unless required or shown on the Contract Drawings

b)	NEMA Size Starter	VA
c)	1&2	200
d)	3	300
e)	4, 5 & 6	500

f) Control power transformers shall be epoxy encapsulated, and core and coil units shall be designed for machine tool applications. Insulation temperature classes shall be 185 degrees Celsius, 115 degrees Celsius rise. Maximum surface temperature shall be 65 degrees Celsius.

g) Control power transformers shall be provided with one secondary lead furnished with a Class H control fuse and clip, and the other secondary lead grounded. Both primary leads shall be provided with Class CC control fuses and clips.

4) Control Relays

a) Control relays shall be provided as required and as shown on the Contract Drawings and conform to the following:

(1) Relays shall be machine tool type, standard or latching solid state time delay type.

(2) Coil voltage shall be 120-volt, 60 Hertz.

(3) Furnished with the number of contacts required to achieve the control logic functions or containing a minimum of two normally open and two normally closed contacts.

(4) Contacts shall be rated 600 volt, rated 10 ampere continuous, and capable of making 7200VA and breaking 720VA.

(5) Contacts shall be bifurcated and convertible unless otherwise shown Contract Drawings.

5) Pilot Devices

a) Pilot devices shall be provided as required and as shown on the Contract Drawings.

b) Pilot devices shall be heavy duty, machine-tool service type.

c) Pilot devices shall be rated 600 volt with contacts rated 10 ampere continuous and shall be capable of making 7200VA and breaking 720VA.

d) Pilot lights shall be LED push-to-test, transformer type.

e) Pushbuttons, selector switches, indicating lights, and other pilot devices shall be provided on unit door-mounted control station.

f) The control station shall be removable for the purpose of mounting and wiring the pilot devices and shall be held in place with mounting screws.

g) Contact blocks of the pilot devices shall be mounted in a recessed control station housing to minimize the hazard of accidental contact when the unit door is opened.

6) Terminal Blocks

a) Terminal blocks shall be mounted on the right side or bottom of the unit compartment for easy accessibility.

b) Terminal blocks shall be pull-apart type on plug-in units for easy removal of the unit from the structure.

c) Power pull-apart blocks shall be three-pole rated 60 ampere at 600 volts, and shall be supplied through NEMA Size 2 starters. A non-pull-apart block rated 195 amps, 600 volts shall be supplied for NEMA Size 3 starters.

d) Terminal blocks on non plug-in units shall be the fixed type.

e) Control terminal blocks shall be rated 20 ampere, 600 volt minimum.

F. Key Interlock Systems

1. Key interlock systems shall be provided to achieve the functionality shown on the Contract Drawings.

2. At a minimum, key interlocks shall be designed to prevent the paralleling of the two sources connected to MCCs configured with main-tie-main breakers.

G. Nameplates

1. The structure and each compartment within shall have identifying nameplates in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems.

2. Abbreviated labels shall be accompanied by their full expanded forms. Each spare and space compartment shall be labeled as such.

3. Nameplates shall clearly indicate information in accordance with Section 26 05 53 – Identification for Electrical Systems, NEMA, and IEEE requirements.

4. Nameplates shall be engraved or embossed on stainless steel.

5. The MCC shall have identifying nameplates in accordance with the requirements of Section 26 05 53 - Identification for Electrical Systems.

6. A master nameplate shall also be provided mounted on the assembly.

7. The master nameplate shall identify MCC designation, voltage, ampere, and short circuit rating, manufacturer's name, general order number, and item number.

H. Equipment Movers

1. The MCC equipment manufacturer shall provide all circuit breakers weighing 50 lbs. and above with a lifting device to facilitate moving the breakers into and out of the MCC and onto a working surface. The lifting device shall be in accordance with the manufacturer's recommendations.

I. Painting

1. Painting shall comply with the requirements of Section 09 91 00 – Painting.

2. All metal surfaces of the MCCs shall be thoroughly cleaned and given one coat of zinc chromate primer.

3. All interior surfaces shall then be given one shop finishing coat of nitro-cellulose lacquer enamel.

4. All exterior surfaces shall be given three coats of the same lacquer. The color of the finishing coats shall be light gray ANSI No. 61.

5. All unit compartment interiors shall be painted white.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Each MCC shall be completely assembled, wired, and tested at the factory, including all buses, connections, insulators, terminals, and terminal blocks, to demonstrate that it has been properly manufactured, properly assembled, is not overheating, is not overloading, and has no electrical or mechanical defects.

2. Shop testing shall be performed on MCCs at the manufacturer's plant prior to shipment.

3. Shop tests shall be in accordance with the latest revisions of IEEE and NEMA and shall demonstrate that the equipment tested conforms to the requirements specified.

4. The Contractor shall provide a shop test report.

a. The report shall identify the tests performed and the results obtained.

5. MCC shop tests shall include the following:

a. Visual and physical inspection of the interior and exterior of the MCC, including all devices to verify consistency with approved submittals.

   1) Check bus layouts and takeoffs confirm with approved submittals.

   2) Check bus for proper electrical clearances.

   3) Check tightness of all bolted and torqued connections.

   4) Key interlock systems shall be tested to ensure operation as specified.

   5) Verify the polarity of all instrument transformers.

   6) Verify the grounding of all instrument transformers.

   7) Verify all nameplate engravings.

b. Mechanical operations shall be performed to ensure proper functioning of operating mechanisms and interchangeability, and that all mechanisms are properly lubricated.

c. Continuity test shall be performed on power and control wires.

d. Functional operations test shall be performed and include pick up, dropout, time delay, sequence, and polarity.

e. Primary hi-potential tests shall be performed.

   1) Primary current carrying parts shall be tested between phases, phase to ground, and line to load.

   2) The applied voltage shall be twice rated voltage plus 1000 for one minute.

f. Hi-Potential tests on control and secondary wiring shall be performed.

   1) Control circuit wiring shall be tested for 1500 volts to ground for one minute or 1800 V for one second.

   2) Power circuits shall be tested phase to phase and phase to ground at 2200 volt for one minute or 2700 volt for one second.

g. Verify connectivity and communication of devices to be connected to the Electrical Monitoring and Communication Systems (EMCS).

h. Simulated operation tests shall be performed to ensure the proper functioning of all controls, control circuits, control devices, and indicators, inclusive of securing and returning all field connected inputs and outputs for each unit of the MCC.

i. Verify the functioning of all meters, HMIs, communications devices, and channels.

B. Witness Shop Tests:

1. The Contractor shall perform witness shop tests in accordance with this Section, Section 01 43 15 – Witness Shop Testing, and the manufacturer's procedures.

2. The Witnessed Shop Test shall not be scheduled before the approval of the Certified Shop Tests.

3. The tests shall be witnessed by the Engineer and two DEP electrical engineers via video call. Shipment of the equipment shall occur after approval by the Engineer and both DEP Electrical Engineers.

4. For the Witnessed Shop Test, the Contractor shall perform all the Certified Tests in the presence of the witnesses.

5. The Contractor shall obtain approval of the testing procedure, test station layout, instrumentation, and report of the Certified Test prior to scheduling the Witness Shop Test.

6. The Contractor shall submit and obtain approval by the Engineer and two DEP electrical engineers of the Witness Shop Test report before the MCCs are released for shipment.

a. The report shall identify the tests performed, the results obtained, contain all raw data sheets, certified test data, calibration certificates, punch lists, and confirmation as to how punch lists items were resolved.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine installation area to ensure there is enough clearance to install MCCs.

B. Verify that installation will yield required working spaces around the MCC installation.

C. Check concrete pads for uniformity and level surface.

D. Verify field measurements are as shown on the approved Shop Drawings.

E. Verify that required utilities are available, conduit stubs etc. are in required location and ready for use.

3.02 INSTALLATION

A. The Contactor shall follow the manufacturer's instructions as to all moving and lifting requirements, connecting of shipping splits, and location in the installation.

B. MCCs shall be level, plumb, and securely installed in accordance with manufacturer's instructions and recommendations.

C. MCCs shall be installed so that sufficient access and working space is provided for ready and safe operation.

D. MCCs shall be installed on concrete pads at locations shown on the Contract Drawings.

E. Leveling steel channels shall be provided for support of the MCC, which shall be securely mounted to surface with anchor bolts.

F. MCC shall be bolted to the concrete bases and shall comply with seismic requirements of Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems and the NYCBC.

G. MCCs shall be wired as per the Contract Drawings and approved Shop Drawings.

H. The MCC shall be properly grounded per NYCEC requirements.

I. The MCC ground shall be connected to the installation ground grid where shown on the Contract Drawings.

J. Conduit entry locations shall be approved and based on manufacturer's Shop Drawings.

K. Conduits entering the MCC shall be furnished with insulated ground bushings, which shall be bonded together and the MCC ground bus.

L. All circuits within MCCs shall be wired together and identified with durable tag secured to cabling twine.

M. The MCC protection and control devices shall be properly adjusted such that the circuits operate correctly and safely.

N. Identification

1. Identify field-installed conductors, interconnecting wiring, warning signs, and components in accordance with Section 26 05 53 – Identification for Electrical Systems.

2. Label each MCC compartment with nameplates complying with Section 26 05 33 – Identification for Electrical Systems.

3. Provide device nameplates complying with Section 26 05 33 – Identification for Electrical Systems.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. After installation, the MCCs shall be field tested for operation and conformance.

2. Field testing shall conform to the requirements in this Section, Section 01 75 10 – Preliminary and Final Field Tests, NETA ATS, and the manufacturer's recommendations.

3. Field tests shall be witnessed by the Engineer and certified by the Contractor.

4. The services of the MCC manufacturer shall be retained for field testing.

5. MCC testing shall be supervised by the manufacturer's representative, prior to energizing equipment.

6. Equipment shall not be energized without the permission of the Engineer.

7. Retain the service of an independent testing firm who shall perform field testing of the MCC.

8. The testing firm shall have experience in the inspection and testing of MCCs and shall be a member company of NETA.

   a. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

B. Preliminary Field Testing

1. Preliminary Field Test of the MCC shall be in accordance with the recommendations of the manufacturer's representative, NETA ATS, and shall consist at a minimum of the following:

2. Visual and physical inspections shall at a minimum verify the following:

   a. Verify all MCC equipment is located according to approved submittals.

   b. Verify all nameplates, tags, and identification marks in accordance with approved submittal and preliminary As Builts.

   c. Physical, electrical, and mechanical condition shall be inspected.

   d. Proper anchorage, required area clearances, physical damage, and proper alignment shall be checked.

   e. Ventilating air passageways shall be inspected for blockage.

   f. Mechanical interlock systems shall be checked for proper operation.

   g. Insulators shall be inspected for evidence of damage or contamination.

   h. Device settings and adjustments shall be verified.

   i. Breakers and vertical sections shall be checked to determine that they have been properly installed, lubricated, and connected.

   j. Equipment shall be cleaned and lubricated as required.

3. Electrical testing shall at a minimum include:

   a. Test continuity of all circuits

   b. All connections shall be inspected for high resistance.

   c. Electrical interlock systems shall be checked for proper operation.

   d. Ground-resistance tests shall be performed.

   e. Perform resistance measurements through bolted connections with a low-resistance measuring device.

f. Perform insulation-resistance measurements on each bus section, phase-to-phase, and phase-to-ground for one minute.

g. An over potential test shall be performed on each bus section, each phase-to-ground and on each switch in the closed position. Test each pole with other poles grounded.

h. Contact-resistance test shall be performed.

i. Control and metering wiring performance test shall be performed.

j. Primary and secondary voltage and current injections shall be performed to confirm phasing, polarities, and transformation ratios.

k. Circuit breaker trip characteristics shall be determined by primary current injection.

l. Control equipment and connections shall be checked to determine that they are not defective.

m. The settings of all protective and monitoring devices shall be confirmed with the full load current rating of the motors and those recommended by Section 26 05 73 – Power System Studies and Section 26 05 75 – ShockHazard and Arc Flash Studies.

C. Preliminary Loading Tests

1. The Contractor may substitute load banks of the type and power factor which are approved by the Engineer to complete Preliminary Load Tests if the actual loads are not ready for energization.

a. The full load rating of the load bank shall be comparable to that of the circuit loads under test.

2. Preliminary Loading Tests shall at the minimum include:

a. Control voltages shall be applied and functional tests verifying the operations of all breakers, controls, and displays.

b. Primary voltage shall be applied to the complete primary bus via the MCC main feeder breakers with tie breakers in the normal operating positions.

1) The primary buses shall remain energized for one hour with no further operations.

a) During this one hour period, all voltage and potential transformer secondaries and circuits shall be checked for voltage magnitudes, phasing, and phase sequence along with all associated metering displays.

2) After one hour, the tie breakers shall be closed, facilitating the energization of the complete bus from either main feeder for one hour.

a) During this one hour period, all voltage and potential transformer secondaries and circuits shall be checked for voltage magnitudes, phasing, and phase sequence along with all associated metering displays.

3) Each MCC outgoing circuit breaker/contactor shall be closed for one hour to energize its associated load/load bank/feeder.

a) During this one hour period, all metering circuits shall be checked for voltage, current, voltamp, and var values, phasing, and phase sequence along with all associated metering displays.

4) All MCC outgoing circuit breakers/contactors shall be closed for one hour to simultaneously energize all loads fed by the MCC.

a) During this one hour period, all metering displays shall be checked.

D. Infrared testing shall be performed once after initial energization of the MCC, and a second time after full load has been applied continuously for (24) hours.

E. MCC Final Field Test

1. MCC Final Field Test shall be considered complete when all the outgoing circuits shall have energized their various loads for the Final Field Test of the respective load.

F. Any deficiencies or issues which may arise during Preliminary Field Tests, Preliminary Loading Test, or Final Field Test shall be remedied by the Contractor at no additional cost to DEP.

G. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the MCC, check the MCC installation before it is placed into operation, and assist in the performance of Preliminary and Final Field Tests.

2. The manufacturer’s representative shall provide MCC equipment Start-up services and Training of the Contractor and the City’s operations and maintenance staff in the care, operation, and maintenance of the MCC in accordance with this Section, the Contract Documents, and the following requirements:

a. Minimum number of manufacturer’s representative Site visits per MCC:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation Supervision	1	2	2
Installation Inspection	1	1	1

Field Testing	2	2	4
Startup	2	2	4
Training	2	1	2

b. Additional trips or days that are required to achieve the proper installation, operation, or training, such services shall be arranged for by the Contractor at no additional cost to DEP.

c. The Engineer shall have the right to reallocate any unused time

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

b. The MCC manufacturer’s representative shall certify in writing to the Engineer that the MCC equipment has been installed, set up, and tested properly in accordance with Contract requirements and is operating at optimum conditions and capacity.

4. The manufacturer’s representative shall also make any necessary adjustments and instruct the Site personnel in its operation and maintenance.

5. The service representative shall sign in and out with the Engineer on each day they are at the Site.

6. A day shall be understood to be the actual time spent at Site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. MCC Startup

1. MCC Startup shall comply with the requirements of Section 01 79 05 – Equipment Start-up and Training and shall be considered completed when all the loads on the MCC completes their startup requirements.

B. MCC Training

1. The Contractor shall provide Training on the MCC in compliance with Section 01 79 05 – Equipment Start-up and Training

2. The Contractor shall submit for approval by the Engineer, lesson plans identifying in detail the training to be conducted.

3. The Contractor shall coordinate training services with the City and the Engineer.

4. The Contractor shall schedule training at least forty-five (45) days prior to delivery of training subject to the approval of the Engineer and the City.

5. The training shall consist of both classroom and field instruction.

6. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any control switches and other equipment required for operation; and to identify locations of any maintenance equipment.

7. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

8. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he/she is at the project.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing low-voltage fuses. Low-Voltage Fuses shall be provided in accordance with the requirements of the Contract Documents.

B. Fuses shall be suitable for use with power circuits.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	3
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	4

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

B. Reference Standards: Low-voltage fuses shall comply with the latest applicable provisions and recommendations of the following, even if not specifically listed in this Section:

1. UL 248 - Low-voltage Fuses.
2. NEMA FU1 - Low-Voltage Cartridge Fuses.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

1. Low-voltage fuses shall be designed, built, and tested in accordance with UL 248.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's catalog cuts for the fuses proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.
2. Time-current curves for the fuses proposed for use.

B. Reports

1. Field Test Reports shall be submitted.
2. Manufacturer's Site visit report shall be submitted.

C. Operation and Maintenance Manual

1. Operation and Maintenance Manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Fuses shall be delivered, stored, and handled in accordance with this Section, the Contract Documents, and the manufacturer's recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Spares

1. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare fuses in accordance with this Section and the Contract Documents.

2. The spare fuses shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

3. Spare fuses shall include at a minimum the following:

a. 10 percent of each rating used.

b. Minimum of three of each rating.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Low-voltage fuses shall be as manufactured by:

1. Mersen Ferraz Shawmut, San Francisco, CA;

2. Littlefuse, Chicago, IL;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Fuses shall be compatible with the system operating voltage shown on the Contract Drawings.

2. Low-voltage fuse ampere ratings shall be as shown on the Contract Drawings.

B. Low-voltage Fuses:

1. Low-voltage fuses shall be current limiting, time delay type. Low-voltage fuses shall have a 200,000 RMS symmetrical ampere interrupting rating.

2. Low-voltage fuses with current ratings up to 600 ampere shall be UL class RK1.

3. Low-voltage fuses with current ratings greater than 600 ampere shall be UL class L.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Fuses shall be installed within equipment in accordance with the manufacturer's recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 29 13 – ENCLOSED CONTROLLERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing enclosed controllers, disconnect switches, and circuit breakers. Enclosed controllers, disconnect switches, and circuit breakers shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	9
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems

B. Section 26 05 53 - Identification for Electrical Systems

C. Section 26 08 11 - General Electrical Testing

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

B. Reference Standards

1.	NYCEC	-	Electrical Code of the City of New York.
2.	UL 98	-	Enclosed and Dead-Front Switches
3.	UL 508	-	Industrial Control Equipment
4.	UL 489	-	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
5.	NEMA KS-1	-	Heavy Duty and Dead-Front Enclosed Switches
6.	NEMA ICS	-	Industrial Control and Systems General Requirements
7.	NEMA ICS 2	-	Industrial Control and Systems, Controllers, Contactors and Overload Relays rated 600V.
8.	NEMA ICS 5	-	Industrial Control and Systems Control-Circuit and Pilot Devices
9.	NEMA ICS 6	-	Industrial Control and Systems Enclosures

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Unless otherwise shown on the Contract Drawings or directed by the standards and codes referenced under this Section, the Contractor shall provide for each low-voltage motor or other power device, complete equipment for starting, stopping, and control.

B. The starting, stopping, and control equipment shall be provided with features of protection, current limitation, and functioning, and be complete with all accessories, appurtenances, and supporting structures.

C. Control equipment shall be UL-listed and properly designed with relation to the characteristics of operation of the motor and/or device controlled.

D. Unless otherwise stated/shown on the Contract Documents, each motor shall be provided with control equipment consisting of an apparatus as follows:

1. Motors of 1/4 HP or less may, in the absence of other requirements, be controlled by a manual motor starter having thermal overload protection at all times.

2. Motors larger than 1/4 HP shall be controlled by a magnetic motor starter.

3. For wound rotor motors of all horsepower ratings, the primary and secondary shall be controlled by a magnetic motor starter or as stated/shown on the Contract Documents.

4. Multiple speed squirrel cage motors shall be controlled by a magnetic motor starter. The magnetic motor starter shall provide adequate protection of the motor at each speed. A line-establishing contactor shall be provided for each motor speed.

E. Each motor shall include overload protection based on latest standards.

1.07 SUBMITTALS

A. Shop Drawings

1. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

a. Manufacturer's catalog cuts, technical information, and enclosure details for the enclosed controllers.

B. Operations and Maintenance Manuals

1. Operations and Maintenance Manuals

a. Operation and Maintenance Manuals shall be submitted in accordance with the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Enclosed controllers shall be delivered, stored, and handled in accordance with the Contract Documents and the manufacturer's instructions

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for the enclosed controllers in accordance with this Section and the Contract Documents.

B. The spare parts shall be listed in an index and packed in containers suitable for long-term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. The following spare parts shall be furnished:

1. One (1) set of contact tips, shunts, and coils shall be provided for each six or less of each size motor starter.

2. One (1) auxiliary contact unit or one set of auxiliary contact tips shall be provided for each six or less motor starter.

3. Two (2) sets of arc chutes shall be provided for each type and rating of magnetic contactor.

4. One (1) timing relay shall be provided of each type installed as part of control equipment installation.

5. One (1) complete auxiliary relay shall be provided of each type installed as part of control equipment installation.

6. One (1) control transformer shall be provided of each rating and type installed as part of control equipment installation.

7. Two (2) complete sets of fuse replacements shall be provided of each rating and type installed as part of control equipment installation.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switching devices shall be as manufactured by:

1. General Electric Company, Stamford, CT

2. Siemens, Washington, DC

3. Or approved equal.

B. Magnetic motor starters shall be as manufactured by:

1. General Electric Company, Stamford, CT

2. Siemens, Washington, DC

3. Or approved equal

C. Manual motor starters shall be as manufactured by:

1. General Electric Company, Stamford, CT

2. Siemens, Washington, DC

3. Or approved equal

D. Control stations shall be as manufactured by:

1. General Electric Company, Stamford, CT

2. Siemens, Washington, DC

3. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Switching Devices

1. Switching devices shall be low-voltage devices provided in accordance with the details shown on the Contract Drawings. The switching devices required under this Section shall be the disconnect switch and circuit breaker types.

2. Switching devices shall be enclosed in NEMA type enclosures in accordance with the requirements specified under this Section and the Contract Documents.

3. Switching device line and load terminals shall be provided with shields to prevent accidental contact with them. In addition, instrument probe holes shall be provided within the shields to permit investigation of the state of the terminals, by authorized personnel and approved procedures.

   a. Disconnect switch type switching devices shall be in accordance with the following:

      1) Switches shall be heavy duty type with number of poles, voltage, and current ratings as shown on the Contract Drawings.

      2) Switches shall be capable of interrupting the full rated current at full rated voltage.

      3) Switch enclosure shall be provided with a viewing window through which it shall be permissible to observe the state of the main contacts and surge protective devices when provided.

      4) Where specifically shown on the Contract Drawings, disconnect switches shall be complete with fuses, surge protective devices, and remote operation.

      5) Switches shall be the quick make and quick break type covered with an arc-resisting barrier. The switch shall be provided with provision for locking in either open or closed position. The ratings shall be as follows:

Switch Rating in Amperes	Motor Horsepower	
	208-240 Volts	480Volts
60	Over 5 to 15	Over 5 to 30
100	Over 15 to 25	Over 30 to 60
200	Over 30 to 50	Over 60 to 125
400	Over 50 to 75	Over 125 to 200

   b. Circuit breaker type switching devices shall be in accordance with the following:

      1) Circuit breakers shall be the molded case type with number of poles, voltage, and current ratings as shown on the Contract Drawings.

      2) Breakers shall be manually or remotely operated thermal magnetic or solid-state type, including inverse-time overload and instantaneous short-circuit protection. Contacts shall be

nonwelding silver alloy and arc extinction shall be accomplished by means of arc chutes.

3) Breakers shall have 100 amp frames as a minimum. Overload protection shall be provided on all poles, with trip settings as shown on the Contract Drawings.

4) Breakers with frame sizes 225 amp or larger shall have interchangeable trip units and adjustable magnetic trip elements.

5) Breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.

6) Breaker enclosures shall be equipped with an external lockable handle with provision for locking in the closed or open position.

7) Where shown on the Contract Drawings, breakers shall be provided with electronic trip units. Electronic trip units shall include long time, short time, instantaneous, and ground fault settings as minimum.

8) Where specifically shown on the Contract Drawings, breakers shall be provided with zone interlocking features, shunt trips, provisions for annunciation of status, and auxiliary devices.

B. Motor Starters

1. Magnetic

1) Magnetic motor starters shall be provided, complete with fused control power transformers, pilot devices, auxiliary contacts, and accessories as stated/shown on the Contract Documents.

2) Magnetic motor starters shall be enclosed in NEMA type enclosures in accordance with the requirements specified under this Section. The starter shall be combination type. The enclosure shall be equipped with an external operable, pad lockable handle, arranged so that it is impossible to open the door unless the breaker is open.

3) The starter shall be magnetic coil operated and shall include a magnetic or solid state motor circuit protector with trip unit range adjustable from 700 to 1300 percent of full load.

4) The combination starters shall be suitable for interrupting the available low-voltage short circuit infeed at the line terminals of the enclosure.

5) Magnetic contactors shall be three-pole, single throw, 60 Hz with auxiliary contacts for under-voltage protection. Contactors shall be mounted upon steel bases with insulated mountings or upon bases of insulating material. Contactors shall be provided with necessary barriers and arc chutes.

6) Contactors shall be NEMA rated as follows:

NEMA Size of Contactor	Motor Horsepower	
	208-240 Volts	480Volts
1	¼ to 71/2	¼ to 10
2	Over 71/2 to 10	Over 10 to 25
3	Over 15 to 25	Over 25 to 50
4	Over 30 to 40	Over 50 to 100
5	Over 40 to 75	Over 100 to 200

7) Contactors in Sizes 1 through 4 shall have double break, silver to silver main contacts. Contactors in Size 5 shall have silver plated tips which close with rolling action and which have self-aligning and self-cleaning features. Auxiliary and interlocking contacts for all sizes shall be of the silver button type. All contact tips shall be easily renewable. Flexible shunts shall be tinned copper braid or tinned extra flexible copper cable.

8) Overload relays shall be of the ambient temperature compensated bi-metallic or solid-state type with interchangeable sensors and manual reset feature. Relay shall include a normally open auxiliary contact for remote alarm purposes. Sensors for overload relays shall be selected to match full load currents of the motors to allow motor operation at maximum safe loads without damage to equipment. Full load current data shall be obtained from the nameplates of motors actually installed.

9) Pilot devices shall be heavy duty type, rated 10 amp continuous. Pushbuttons, selector switches, indicating lights, and other devices shall be located on the starter enclosure. Indicating lights shall be push-to-test, LED, transformer type with 12-volt secondaries.

10) Relays shall be standard, latching type and pneumatic or solid-state time delay type. Relays shall be provided with contacts rated 10 amp with number as required.

11) Special overload protection shall be provided where definite purpose motors cannot be protected by standard thermal overload relay applications.

2. Manual

a. Manual motor starters shall be provided complete with pilot devices as shown on the Contract Drawings.

b. Manual motor starters shall be enclosed in NEMA type enclosures in accordance with the requirements specified under this Section.

c. Manual motor starters shall be toggle operated, NEMA horsepower rated, single-phase type with thermal overload protection unless shown otherwise on the Contract Drawings. Pilot devices, when required, shall be in accordance with the requirements specified under this Section.

d. Where shown on the Contract Drawings, manual motor starters shall be low-voltage, three-phase type without overload protection for use as manual starting disconnect switches. The switches shall be a minimum of NEMA size 1 horsepower rated, as required for the application intended.

3. Control Stations

a. Control Stations shall be provided in accordance with the details on the Contract Drawings.

b. Control Stations shall be enclosed in NEMA type enclosures in accordance with the requirements specified under this Section.

c. Control stations shall be industrial, heavy duty, oil tight construction with clearly marked legend plates. Stations shall have operating devices as shown on the Contract Drawings.

d. Contact ratings shall be 10 amp minimum. All indicating lights shall be LED, transformer type, and lens color shall be as shown on the Contract Drawings.

4. Enclosures

a. Enclosures shall be provided for the enclosed controllers.

b. Enclosures located indoors in dry, dusty areas shall be gasketed and shall be constructed of 14-gauge sheet steel.

c. Cabinet type enclosures shall include hinged and gasketed front doors.

d. Enclosures shall be provided in accordance with NEMA requirements as required for the area classifications indicated on the Contract Drawings.

1) For dry, dusty locations, enclosures shall meet NEMA 12 requirements.

2) For wet and corrosive locations, enclosures shall meet NEMA 4X requirements. NEMA 4X enclosures shall be fabricated from Type 316 stainless steel.

3) Enclosures within hazardous locations shall meet Class 1, Division 1, Group D requirements. Hazardous enclosures shall be fabricated from cast metal.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Equipment shall be mounted so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Equipment shall be securely fastened to walls or other surfaces on which they are mounted.

C. Independent supports shall be provided where no wall or other surface exists.

D. Enclosed controllers shall be installed in conformance with the NYCEC.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing standby power. Standby power shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. Standby power required under this Section shall be EPA certified Tier 2 diesel engine generator sets. The generator sets shall include all appurtenances for a complete functioning standby power generating system.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	15
PART 3	EXECUTION	17
3.01	Examination / Preparation	17
3.02	Installation	17
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	19
3.05	Adjusting / Protection / Cleanup	20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 53 - Identification for Electrical Systems.

B. Section 26 29 13 - Enclosed Controllers.

1.04 REFERENCES

A. Standby power generator sets shall comply with the latest applicable provisions and recommendations of the following:

1.	IEEE 446	-	Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
2.	ISO 3046	-	Performance Standards for Reciprocating Internal Combustion Engines
3.	ISO 8528	-	Reciprocating Internal Combustion Engines
4.	NEMA MG1	-	Motors and Generators.
5.	NEMA AB1	-	Molded Case Circuit Breakers.
6.	NETA ATS	-	NETA Acceptance Testing Specification.
7.	NFPA 30	-	Flammable and Combustible Liquids Code.
8.	NFPA 37	-	Standard for Installation and use of Stationary Combustion Engines and Gas Turbines.
9.	NFPA 110	-	Standard for Emergency and Standby Power Systems.
10.	NIST	-	National Institute of Standards and Technology.
11.	NYCBC	-	New York City Building Code.
12.	NYCEC	-	New York City Electrical Code.
13.	NYCMC	-	New York City Mechanical Code
14.	NYCNC	-	New York City Noise Code.
15.	UL-142	-	Steel Aboveground Tanks for Flammable and Combustible Liquids
16.	UL 508	-	Industrial Control Equipment.
17.	UL 2200	-	Standard for Stationary Engine Generator Assemblies.

1.05 DESCRIPTION

A. The generator sets shall be designed, built and tested in accordance with the latest applicable editions of ISO 9001, NFPA, NEMA and EGSA and UL.

B. The operating environment of the generator set shall be as follows:

1.	Ambient temperature	-	0 to +104 degrees F
2.	Height above sea Level	-	0 to 1000 feet
3.	Relative Humidity	-	95 percent non-condensing

C. The generator set shall meet the latest EPA air emission requirements applicable at the time of installation.

D. The generator set shall comply with NYCNC and NYCBC.

E. The generator shall comply with Chapter 13 of the NYCMC.

F. The generator sets shall operate from No. 2 ultra-low sulfur diesel fuel and be equipped with all necessary accessories.

G. The generator sets shall be rated for continuous 24-hour per day operation, without deration, for the duration of any normal utility outage up to a maximum of 30 consecutive days.

H. The generator sets telephone influence factor shall be less than 50 in accordance with NEMA MG1-22.43.

I. The nominal ratings of the generator set including kVA, kW, power factor, voltage, number of phases, frequency and speed of the engine generator sets shall be as shown on the Contract Drawings.

J. The generator sets shall have suitable motor starting capability to limit the voltage dip to less than 10 percent under the most severe starting conditions for designated motors when starting the motors with a miscellaneous power and lighting pre-load on line. The starting motor horsepower size, starting method and preload KVA shall be as shown in the Contract Drawings.

K. The generator sets shall have identifying nameplates in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems. Alternator nameplates shall also be in accordance with NEMA MG1.

L. When shown on the Contract Drawings, the generator sets shall be designed for outdoor installations.

1.06 QUALITY ASSURANCE

A. General:

1. Each generator set shall be of current manufacture and the standard product from a firm regularly engaged in the production of such equipment specified in this Section, the as per the Contract Documents.

2. The firm shall have a minimum of 20 years' experience in designing, supplying and supporting engine generators sets.

3. Each generator set shall be factory assembled in an ISO 9001 certified engine manufacture facility and tested to determine that it is free from electrical or mechanical defects and to assure that it meets the Contract Documents.

4. Assembly by integrators or packagers who are not the single manufacturer of the generator set engine will not be approved.

5. The engine shall be certified at the time of manufacture and carry a prominent nameplate listing all information necessary to secure an EPA Certificate of Conformity.

6. Each generator set shall be adequately guarded both physically and electrically for protection of operating personnel.

7. All materials, equipment and parts comprising each generator set shall be new, of current manufacturer and of the highest grade. All components shall be covered by the manufacturer's standard warranty on new machines.

8. The generator set manufacturer shall have complete parts and service facilities and a factory-trained serviceman, located within a hundred miles of the project site, available on a 24-hour basis. Services shall be readily available so to avoid long periods of interruption or require extensive spare parts inventory.

9. Unless otherwise authorized by the Engineer, the manufacturer's service representative shall be direct employee of the equipment manufacturer, with at least five (5) years of experience in the installation, testing and startup of equipment specified herein. Manufacturer's sales and marketing representatives shall not be accepted as manufacturer's service representative.

10. The generator set manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all factory tests. Calibration of testing apparatus shall be within one year.

11. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the NIST and the NETA ATS.

B. Field Tests:

1. The generator set shall be field tested. Field testing shall be performed in accordance with the requirements specified under this Section.

2. The services of the generator set manufacturer shall be retained for field service. Field service shall be in accordance with the requirements specified under this Section.

3. Retain the service of an independent testing firm who shall perform field acceptance testing of the generator set. The testing firm shall have experience in the inspection and testing of the equipment and shall be a member company of NETA.

4. Acceptance testing shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer's technical information which shall include:

a. Standard published curves of engine-generator set rating. Special or maximum ratings are not acceptable.

b. Calculations confirming motor starting capability.

c. Calculations confirming the sizing of all batteries.

d. Published data of the generator line and machine constants.

e. Published data of fuel and oil consumption estimates, based on engine manufacturer's data.

f. Published manufacturers estimated data of cooling and combustion air flow requirements, plus heat rejection of the engine and generator when operating at full load.

g. Proof of compliance with all local codes in particular compliance with the requirements for noise control, type of fuel to use, exhaust emissions and seismic criteria.

h. Complete installation drawings with wiring diagrams and interconnections.

i. Complete generator enclosure details, including equipment arrangement drawings and specifications.

j. Manufacturers literature, bills of materials, specifications, Engineering data and installation instructions necessary to fully describe engine-generator set and all appurtenances and to substantiate compliance with the specified requirements.

k. Appendix A details the technical information, which shall at a minimum accompany or be a part of the technical information submitted.

2. Description of shop, field and acceptance testing methods, procedures and apparatus with calibration dates shall be submitted for approval. Shop testing shall include both witnessed and non-witnessed testing. Testing methods and procedures shall be submitted at least 90 days in advance prior to conformation of each of above testing dates and actual testing.

3. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.

B. After review by the Engineer the Contractor shall submit drawings of the generator set drawings and proposed installation to the Fire Department of NYC for review and approval.

C. Certificates of Compliance

1. Data and results of witness tests accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to site shall proceed.

D. Reports

1. Shop test and field test reports shall be submitted.

2. Manufacturer's site visit and acceptance testing reports shall be submitted.

E. Operation and Maintenance manuals covering all equipment provided shall be submitted in accordance with this Section and the Contract Documents. The Operation and Maintenance Manuals shall at minimum contain:

1. Manuals and procedures annotated to show or describe only the specific equipment installed.
2. Complete As-Built Drawings
3. Material Summaries
4. Component Instruction
5. Sequence of Operation
6. Complete Nameplate Schedule

1.08 DELIVERY, STORAGE, AND HANDLING

A. Generators and accessories shall be delivered, stored and handled in accordance with this Section, the Contract Documents, the generator manufacturer's instructions and the following:

1. Generators shall be inspected for shipping damage when received.
2. All sleeve or oil lubricated bearings generators shall be identified and the bearing reservoirs filled to normal level.
3. Generators shall be handled using base lifting lugs. Avoid pounding or bumping of generator which may damage unit. A hoist and spreader bar arrangement shall be used to avoid damage.
4. Generators shall be stored indoors in clean, dry heated areas. Provisions, such as the energization of heaters, shall be made to prevent moisture from condensing within or on the generator set and its accessories.
5. Generators shall not be stored in areas subject to continuous vibration. A small quantity of grease shall be injected into each bearing on a monthly basis. Purged grease shall be inspected for water or rust.
6. The Contractor shall provide the service of a manufacturer's representative authorized to witness and advise on the unloading of the generator set and all accessories at site.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts, special tools and supplies for the generator sets.

B. The spare parts, special tools and supplies shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. Spare parts, special tools and supplies shall be furnished in accordance this Section, the Contract Documents and the manufacturer's recommendations for the generator size and type.

D. Spare parts which shall be provided shall include at a minimum the following:

1. Two complete sets of air, oil and fuel filters of each type and size used.
2. One complete set of belts and hoses of each type and size used.
3. Two sets of control power fuses of each type and size used.
4. Two per ten pilot lights of each size and type used.

E. The Contractor shall furnish as part of the bulk lubricant order the quantity of lubricants required to operate and maintain the generators furnished under this Section for a period of one year after acceptance.

1. As a minimum, there shall be provided sufficient oil and grease to make a least one lubricant change for each generator as applicable.
2. Replace all lubricants used during startup and testing prior to acceptance of equipment. Furnish this replacement lubricant in addition to the lubricants included in the bulk order.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Engine generator sets shall be as manufactured by:

1. Caterpillar Inc., Peoria, IL;
2. Cummins Inc., Columbus, IN;
3. Or approved equal.

B. Generator set enclosure shall be as manufactured by:

1. Lectrus, Chattanooga, TN;
2. Or approved equal.

C. Engine governor shall be as manufactured by:

1. Woodward Inc., Loves Park, IL;
2. Or approved equal.

D. Engine sub-base fuel tank shall be as manufactured by:

1. Lectrus, Chattanooga, TN;
2. Or approved equal.

E. Alternators shall be as manufactured by:

1. GE, Fairfield, CT;
2. Cummins Generator Technologies, Fridley;
3. Or approved equal.

F. Alternator voltage regulator shall be as manufactured by:

1. Basler Electric Company, Highland, IL;
2. Or approved equal.

G. Battery Chargers shall be as manufactured by:

1. Basler Electric Company, Highland, IL;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Engine

1. Each generator set shall include an engine. The engine shall be configured for generator set service and be of the internal combustion-diesel type. The engine shall be equipped to operate on ultra-low sulfur diesel fuel and include radiator cooling, with engine driven water pump, expansion tank with temperature control modulating valve, lube oil pump, lube oil coolers, air filters, fuel filters and temperature and pressure gauges to monitor the charge air system, the jacket water systems and the lube oil system.
2. Without any overloading and with all the engine and alternator accessories active the net horsepower of the engine at the rated speed, shall not be less than that required to produce the rated kW output at the ambient temperature and altitude specified.
3. The engine shall be constructed with cast iron cylinder heads and steel backed bearings. Pistons shall be aluminum alloy with chrome faced rings. The engine crank case shall be reinforced cast iron. The crank case shaft shall be forged alloy steel with hardened journals, finished and dynamically balanced.
4. The engine shall be equipped with speed governing system which includes a solid state isochronous governor. The governor shall maintain frequency within 1/4 percent of its mean value for constant loads from no load to full load. The engine shall have a 3 seconds maximum transient recovery time for one-step load acceptance and a 7 percent maximum transient frequency dip on one-step application of a 0.8 power factor load at 80 percent of unit full load rating. Where multiple generating set are required to be run in parallel to satisfy the load requirement the governor requirements shall be as specified.

5. The speed governing system shall be equipped with the following provisions:
    a. Overspeed shutdown
    b. Engine over crank shutdown,
6. Engine cooling system shall consist of an engine-mounted radiator with blower type fan, sized to maintain safe operation. The coolant system shall be filled with a 50 percent solution of ethylene glycol, water and rust inhibitor.
7. Engine cooling system shall also comprise an engine driven, centrifugal type circulating water pump, thermostatic valves to maintain the engine at the recommended temperature and be equipped with the following accessories.
    a. High engine temperature shutdown.
    b. Loss of coolant shutdown.
    c. Coolant level sensors.
    d. Cooling water temperature gage.
    e. Coolant drain line with valve.
    f. Fan guard.
    g. Radiator face duct connection.
8. When shown on the Contract Drawings, the engine radiator shall be remote mounted in a vertical or horizontal configuration.
9. Remote mounted radiators shall be designed for low noise operation with fan driven by a totally-enclosed fan cooled electric motor.
10. The engine shall be equipped with jacket water heaters. Heaters shall be in be in accordance with the following:
    a. Thermostatically controlled, of sufficient capacity to keep the jacket water at a suitable temperature for trouble-free starting over the range of the ambient temperature specified in this Section.
    b. Heater shall be provided with a suitable contactor to automatically disconnect the heater when the engine is started. Heater shall operate at 120 VAC single phase.
11. Engine lubrication system, including engine driven lube oil pump, shall be equipped with the following accessories:
    a. Lube oil temperature gage.
    b. Lube oil pressure gage.
    c. Oil level indicator.
    d. Low oil pressure shutdown.

e. Oil drain lines with valves

12. Engine fuel system shall operate with No. 2 ultra-low-sulfur diesel fuel and consists of all piping and valves required between the engine and day tank. The system shall include a fuel pressure gage.

B. Alternator

1. Each generator set shall be provided with an alternator. The alternator shall be engine-driven, single or two bearing type, 60 Hz, synchronous, revolving field with brushless excitation and drip-proof, guarded construction. The alternator shall be coupling connected to the engine flywheel housing to ensure permanent alignment.

2. The alternator shall be self-ventilated and have one piece cast aluminum alloy low noise cooling fan.

3. The windings' insulation shall be Class H in accordance with NEMA MG1. The stator winding shall be non-hydroscopic, fungus resistant, tropicalized and shall be given multiple dips and bakes of varnish under vacuum, plus a final coating of epoxy for extra moisture and abrasion resistance. Unless otherwise specified, temperature rise shall not exceed 130 degrees C rise over 40 degrees C ambient.

4. The rotor shall be dynamically balanced and include amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions.

5. The alternator shall be equipped with a static electronic voltage regulator to maintain voltage within plus or minus 1/2 percent under load, from no load to 100 percent load. The regulator shall also maintain the random voltage variation for constant loads within plus or minus 1/2 percent under load, from no load to 100 percent load.

6. The alternator shall be equipped with an excitation support system. The system shall consist of a permanent magnet exciter to provide a dedicated source of power for the exciter field. The permanent magnet exciter shall isolate the excitation system and sustain 300 percent short circuit current, under any short circuit condition, for up to 10 seconds.

7. The alternator shall be equipped with space heaters. Space heaters shall be 120-volt, single phase, of sufficient wattage to maintain the temperature approximately 5 degrees above ambient when the generator is idle. Space heaters shall be disconnected when generator is running.

C. Air Supply/Exhaust System

1. Each generator set shall be provided with an air supply/exhaust system. The air supply/exhaust system shall consist of a heavy duty air cleaner, silencer and exhaust piping of suitable size, configuration and material in accordance with engine manufacturer's recommendations. The exhaust systems shall include ports for emission testing.

2. Exhaust piping shall be welded schedule 40 stainless steel with standard bend radius and stainless steel flexible exhaust fittings. All indoor exhaust piping shall be insulated to maintain a surface temperature not to exceed 50 degrees C.

3. The exhaust silencer shall be critical grade type or better to meet the required sound attenuation specified, and shall be constructed of double plate sheet with condensate drain ports. The inlet and outlet ANSI flanges shall be Type 316 SS. The connection to the engine shall be a stainless steel expansion joint and if required the outlet also.

D. Starting System

1. Each generator set shall be provided with a battery system. The battery system shall consist of batteries, cables and a battery charger and shall be used for engine starting, powering the engine control module and powering electric actuators, instrumentation and protective devices.

2. Batteries shall be long life, heavy duty lead acid type, with number of cells, voltage and rating in accordance with requirements of the engine manufacturer. The batteries shall be sized for a minimum of six (6) crank cycles of the specified engine and have sufficient current available for break-away of the particular engine at worst case temperature while at the same time powering the other peak connected loads.

3. Battery cables and connectors shall connect the starting motor and the generator control panel to the battery supply.

4. Battery charger shall be automatic float type, current limited with 120 volts, 60 Hertz input. The battery charger shall be capable of recharging a discharged battery in 12 hours while carrying normal loads. The battery charger shall be equipped with the following additional features and accessories:

a. Equalizing switch and equalizing timer.

b. DC ammeter.

c. DC voltmeter.

d. DC cranking disconnect relay.

e. Low-high DC voltage alarm relay.

f. Current failure relay.

5. The battery system shall be provided with a suitable rack for mounting batteries and battery charger.

E. Fuel System

1. Day Tank:

a. Each generator set shall be provided with a day tank. The day tank shall be reinforced steel, construction suitable remote mounting in location as shown on the Contract Drawings..

b. The day tank shall be constructed in accordance with NFPA 30, NFPA 37 and NFPA 110. The day tank shall be UL-142 listed.

c. The day tank shall include fittings and vents as required for fuel supply, return, manual fill, normal and emergency venting. The day tank shall be treated with two coats of rust inhibiting primer and two coats of standard finish paint.

d. The day tank capacity in gallons shall be as shown on the Contract Drawings. The day tank shall be constructed with a rupture basin to contain liquids resulting from a spill, tank leak or rupture. The rupture basin capacity in gallons shall be 10 percent greater than the day tank.

e. The day tank shall be equipped with the following additional features and accessories:

f. Leak detection switch.

g. Low fuel level switch.

h. High fuel level switch.

i. When shown on the Contract Drawings the day tank shall be equipped with immersion heaters. Heaters shall be in accordance with the following:

j. Thermostatically controlled, of sufficient capacity to keep the fuel temperature at 50 degrees F above the ambient temperature stated in this Section.

k. Heater shall be provided with a suitable contactor to automatically disconnect the heater based upon temperature and if the fuel level decreases to the heater level. Heater shall operate at 120 VAC single phase.

F. Control Panel

1. Each generator set shall be provided with a unit-mounted control panel. The control panel shall include the necessary controls, instruments and lights to manually and automatically start, stop and monitor the generator unit.

2. The control shall be UL 508 listed. The panel control shall be microprocessor based with programmable adjustments and shall provide monitoring, metering and control of the system based upon the manufacturer's standard arrangement. Control power to the panel shall be DC supplied from the starting battery system.

3. The panel controls shall include the following:

a. Automatic engine starting control from a single pole contact which closes for engine run and opens for engine stop.

b. Automatic cranking controls to disconnect engine while running.

c. Four, 7 seconds minimum, cranking cycles with cranking attempts separated by appropriate rest periods.

d. Cranking controls shall be locked out, requiring manual reset, if engine fails to start at the completion of the starting program.

e. Overspeed shutdown.

f. Overcrank shutdown.

g. 0 to 60-minute adjustable timer for cool down after the transfer of load to utility power.

h. Three Position Selector Switch: Manual Start-Off-Auto Start, and Start-Stop Pushbuttons.

i. Voltage adjusting rheostat.

j. Auxiliary contacts for controlling generator space heaters.

4. The panel malfunction protection, status and alarm indicators and accessories shall include the following:

a. Shutdown and alarm annunciation:

1) Engine high water temperature.

2) Engine low oil pressure.

3) Engine overspeed.

4) Engine overcrank.

5) Low coolant level.

b. Alarm annunciation without shutdown:

1) Engine low water temperature.

2) Engine high water temperature pre-alarm.

3) Engine low oil pressure pre-alarm.

4) Battery charger malfunction.

5) Day tank low level.

6) Day tank high level.

7) Day tank leak.

5. Normally open contact, common for all alarm conditions, for remotely indicating generator malfunction.

6. Normally open contact, for remotely indicating generator run.

7. Wattmeter and power factor meter.

8. Elapsed time meter.

9. Ammeter, voltmeter and phase selector switches.

10. Frequency meter.

11. Oil pressure and temperature gauges, coolant temperature gauge and battery voltmeter.

12. The unit mounted control panel shall be completely pre-wired. All instruments, controls and indicating lights shall be suitably mounted and properly identified. All wires and terminals shall be individually identified.

13. When shown on the Contract Drawings, the panel controls shall be arranged to accept a stop signal from a remote stop station. The remote station shall provide emergency shutdown of the generator set.

G. Circuit Breakers

1. The generator set shall be provided with unit mounted main circuit breaker and exciter circuit breaker, sized for protecting the unit.

2. Circuit breakers shall be in accordance with the requirements of Section 26 29 13 – Enclosed Controllers.

H. Enclosure

1. The generator sets shall be provided with a protective enclosure. The enclosure shall completely enclose the entire generator set, including day tank, starting system and air supply/exhaust system.

2. Protective enclosures shall be walk-in type.

3. Walk-in type enclosures shall be custom built for proper access of all components within. Dimensions shall be based upon actual furnished equipment. The equipment arrangement, shall at a minimum, provide 3 feet clear from the generator frame to the front of the deepest wall mounted panel or enclosure. Walk-in type enclosures shall be in accordance with the following:

a. The enclosure shall be pre-painted aluminum stressed skid construction consisting of the following:

b. The roof shall consist of one piece roof sheet, .040-inch-thick, 3003 aluminum alloy with extruded aluminum recessed side and end rails and I beams, 6061-T6 alloy.

c. The side walls and end walls shall be formed from panels, .050-inch-thick, 5052 H-34 aluminum sheet, riveted 3 inches on center, with extruded aluminum post sections on 24 inch centers.

d. The floor and underframe shall consist of two 6 inch wide flange I beam longitudinal skids with 10 gauge steel crossmembers on 12 inch centers, overlayed with 3/4 inch tongue and groove exterior FIR plywood subfloor surfaced with 1/8 thick diamond plate steel.

e. Doors shall include an aluminum frame and personnel door fully gasketed to form a weather tight seal.

4. Louvers shall be provided and sized as required for sufficient engine combustion and radiator cooling. Louvers shall be motorized and of aluminum construction riveted into the steel frame forming a rigid water resistant assembly.

   a. The enclosure shall be completely wired with the following accessory equipment:

   b. A 120/208 volt, single phase load center panel with circuit breakers for all power requirements including lighting, convenience receptacle, battery charger, day tank, and heaters.

   c. Vapor tight lighting fixtures within the enclosure with a snap switch at the entrance door.

   d. Duplex convenience receptacle.

   e. Battery-powered emergency lighting fixture positioned to light the engine starting controls.

5. The generator enclosures shall provide sound attenuation of 80 dB(A) at 3ft from the generator enclosure.

I. Painting

1. All ferrous metal surfaces shall be cleaned and painted with a rust inhibiting primer. All exterior surfaces shall be given three coats of manufacturer's standard finish paint. Finish paint shall be suitable for the operating temperature.

2. Color of finish paint shall be manufacturer's standard color.

3. Generator enclosures when required shall be primed with two coats of zinc-chromate. The enclosure exterior shall be finished painted with three coats of enamel. Color of finish paint to be selected by Engineer from manufacturer's standard color chart.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the generators at the manufacturer's plant prior to shipment.

2. Shop test shall be in accordance with the latest revisions of NEMA MG1 and shall demonstrate that the equipment tested conforms to the requirements specified and shown on the Contract Drawings and the corresponding approved submittals.

3. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

4. The completed generator set for each unit shall be tested at the manufacturer's factory. The generator set shall be tested for a period of two hours at full load, 0.8 power factor with suitable load banks.

5. The test may include the manufacturer's standard test procedure, but at minimum shall include the following:
    a. Verify generator set assembly, prior to operation, including all mechanical and electrical connections.
    b. Verify fuel and lubrication systems are clean and filled with proper grades of fuel and lubricants.
    c. Make adjustments as required to governor and voltage regulator controls.
    d. Inspect operation of all gauges, switches and meters. Verify generator set monitoring meters against calibrated load bank meters.
    e. Verify operation of all safeties and alarms.
    f. Maintain records of unit operation, at 15 minute intervals, for duration of test.
    g. Records at a minimum shall include, jacket water temperature, oil pressure, ambient air temperature, voltage, current, frequency, kilowatts and power factor.

B. Witnessed Shop Tests:
1. The Contractor shall perform witnessed shop tests in accordance with this Section and the Contract Documents.
2. The test may include the manufacturer's standard test procedure, but at minimum shall include the following:
    a. an inspection
    b. a loading test.
3. The inspection shall include:
    a. Verify generator set assembly, prior to operation, including all mechanical connections and arrangements, all electrical connections, all test connections, and all test equipment locations.
    b. Verify fuel and lubrication systems are clean and filled with proper grades of fuel and lubricants.
    c. Static verification of all safeties and alarms.
4. The load test shall include the operation of the generator on suitable load banks to achieve a 0.8 power load and stabilization of all temperatures over three consecutive recording periods at 100% as follows:
    a. Maintain records of unit operation, at 15 minute intervals, for duration of test.
    b. Records at a minimum shall include, jacket water temperature, oil pressure, ambient air temperature, voltage, current, frequency, kilowatts and power factor.

c. Inspect operation of all gauges, switches and meters.

d. Verify generator set monitoring meters against calibrated test instrumentation.

e. Make adjustments as required to governor and voltage regulator controls

f. 30% load for half an hour

g. 50% load for half an hour

h. 75% load for half an hour

i. 100 % load for two hours

j. 100% load rejection and acceptance tests

5. The Certified Test shall be completed and approved before the scheduling of the Witnessed Test.

6. The contractor shall provide a live video shop witness test for the Engineer and two DEP electrical engineers. Shipping will only occur after test approval from the Engineer and the two DEP electrical engineers

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install generator sets in accordance with the manufacturer's instructions and recommendations.

B. The generator set shall be mounted on a common structural steel frame base. The base shall be provided with vibration isolators consisting of steel springs in combination with rubber pads and anchor bolts. Anchor shall be in compliance with the manufacturer’s recommendations.

C. A template shall be furnished by the manufacturer for setting anchor bolts, pipe sleeves, and nuts for mounting the isolators to the concrete foundation. Stainless steel bolts and nuts shall be furnished for bolting the isolators to the channel frame base of the engine-generator set.

D. Flexible connections shall be provided between the generator set and all off-skid supply and return lines, supply and discharge ducts, electrical power, control and instrumentation conduits and other externally connected support systems.

E. Provide services of a qualified factory representative to inspect in detail the installation of the generator set and related auxiliary systems prior to the commencement of Field Tests detailed in this Section.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, generator sets and systems associated with, shall be field tested for operation and conformance.

2. The Contractor shall perform field tests in accordance with this Section , and the Contract Documents..

3. The field tests shall be witnessed by the Engineer and certified by the Contractor.

4. Generator set testing shall be performed by the manufacturer's representative, prior to energizing equipment. Equipment shall not be energized without the permission of the Engineer. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall include at a minimum demonstrate the following:

   a. The entire installation has been made in accordance with the approved manufacturer's drawings, and that the unit and all auxiliaries are ready for operation.

   b. Fuel and lubrication systems are complete, clean and filled with the proper grades of fuel and lubricants.

   c. The units and all subsystems start, operate, and shutdown in accordance with manufacturer's recommendations.

   d. All safeties, alarms and shut-downs function at the correct set point and sequence.

   e. The unit accepts load, governs speed and regulates voltage.

B. Manufacturer’s Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the generator sets, check the generator set installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations and train the Contractor and the City’s operations and maintenance staff in the care, operation and maintenance of the generator sets.

2. The Contractor shall provide equipment start-up services and training in accordance with this Section, the Specifications and the Contract Documents and the following requirements:

   a. Minimum number of manufacturer’s representative site visits per type of generator set:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation	2	1	2
Field Testing	2	1	2

Startup	2	1	2
Training	2	1	2

3. Any additional time required to achieve a successful installation shall be at the expense of the Contractor.

4. The Engineer shall have the right to reallocate any unused person-days.

5. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.

6. The service representative shall sign in and out with the Engineer on each day they are at the site. Person-days shall be understood to be the actual time spent at site and does not include travel to and from the site.

3.04 STARTUP / DEMONSTRATION

A. Acceptance Testing

1. The Contractor shall provide acceptance testing of the generator sets.

2. All acceptance testing shall be performed by the testing firm, after the completion of the field tests specified under this Section and preliminary approval of the Operation and Maintenance Manual.

3. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

4. Acceptance testing shall be performed on each generator set. Each set shall be tested in load increments using portable resistance type load banks and plant loads . Testing shall include the following:

a. Perform functionally tests to verify generator set shutdown features operate as required.

b. Perform vibration base line test.

c. Unit shall be operated for a simulated power failure test. Tests shall be initiated by simulating a failure of the normal supply. Tests shall end by returning normal supply.

d. Apply the actual plant loads available plus load banks necessary to total full load. Unit shall be load tested, 30 minutes at 25 percent load, 30 minutes at 50 percent load, 30 minutes at 75 percent load and three hours at 100 percent load.

e. At each load increment the test duration shall not commence until all generator set engine and alternator temperature show no more than one-degree change over three successive 5 minute period.

f. Records shall be maintained, at 5 minute intervals, for duration of each test.

g. Records at a minimum shall include fuel consumption, water temperature, oil pressure, ambient air temperature, voltage, current, frequency, kilowatts, power factor and sound level at 3ft from each side of the enclosure.

B. Acceptance electrical testing shall be performed on each alternator. Testing shall include the following:

1. Insulation-resistance tests shall be performed on each alternator winding with respect to ground.

2. Determine polarization index.

C. All tests and values shall be in accordance with the manufacturer's recommendations and NETA ATS.

D. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

APPENDIX A:

The information listed below represent the minimum technical content which shall be a part of submittals to be made for the generator set.

Engine Data:

1. Manufacturer
2. Model
3. Number and arrangement of cylinders
4. RPM
5. Bore and stroke
6. Piston displacement (cubic inches)
7. Maximum engine power at rated rpm
8. Brake mean effective pressure (BMEP) at rated kW (including any parasitic loads and alternator efficiency)
9. Piston speed (ft./min), materials of construction, fan performance, motor details
10. Make and model of governor
11. Make and model of over-speed shutdown device
12. Maximum allowable exhaust back pressure (inches water column)
13. Engine cold cranking amps
14. Guaranteed fuel consumption rate:

    Full load (gal/hr)

    Three quarters load (gal/hr)

    Half load (gal/hr)

Alternator Data:

1. Manufacturer
2. Model
3. Rated kVA, Rated kW
4. No of Wires
5. Voltage, Frequency
6. Temperature rise above 40 degrees C ambient

    Stator by thermometer (degrees C)

    Field by resistance (degrees C)
7. Class of insulation

8. Alternator sub-transient reactances X1, X2, X0 and other reactances and resistances (P.U. on machine KVA base)
9. Motor starting capability
10. Alternator efficiency including excitation losses and at 80 percent power factor:

    Full load (percent)

    Three-quarters load (percent)

    Half load (percent)

Generator unit and accessories:

1. Weight of skid mounted unit (pounds)
2. Overall length (inches)
3. Overall width (inches)
4. Overall height (inches)
5. Exhaust connection size (inches)

Guaranteed Engine exhaust gas emission data maximum values (not to exceed) at full prime load, ¾ load ½ load and ¼ load:

1. Temperature (degrees F)
2. Flow (ACFM)
3. Carbon Monoxide (CO) (grams/BHP-hr)
4. Nitrogen Oxides (NOx) (grams/BHP-hr)
5. Volatile Organic Compounds (VOC) (grams/BHP-hr)
6. Sulfur Dioxide (S02) (grams/BHP-hr)
7. Particulates (grams/BHP-hr)

Engine heat rejection (BTU/min)

1. Heat radiated to room by engine
2. Heat to jacket coolant
3. Heat to oil cooler
4. Heat to after cooler
5. Heat to exhaust
6. Heat to fuel
7. Radiator fan rate (CFM)

Coolant data:

1. Jacket coolant flow rate (gpm)
2. Jacket coolant outlet temperature (degrees F)

3. Maximum allowable jacket coolant return temperature (degrees F)
4. Aftercooler coolant flow rate (gpm)
5. Aftercooler coolant outlet temperature (degrees F)
6. Maximum allowable aftercooler coolant return temperature (degrees F)
7. Total coolant required for replacement (gallons)

Engine heat rejection (BTU/min)

Combustion air volume (CFM)

Height from bottom of skid required for removing piston with connecting rod (also for removing cylinder liner) (feet)

Nominal ampere-hour rating and cold (-30 degree F) cranking amps of the starting battery(ies), (AH), (CCA) and sizing data for batteries.

Radiator:

1. Air flow rate (cfm)
2. Fan horsepower (bhp)
3. Fan blade tip speed (fps)
4. Fan noise rating at 50 feet (dbA)

END OF APPENDIX A

NO TEXT ON THIS PAGE

SECTION 26 32 23 – GENERATOR QUICK-CONNECT CABINETS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Generator Quick-Connect Cabinets, also called "quick-connect cabinets" or "generator docking stations," shall be provided in accordance with the requirements specified under this Section, and the Contract Documents.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	9
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 15 - Witness Shop Testing

B. Section 01 75 10 – Preliminary and Final Field Tests

C. Section 01 79 05 - Equipment Start-up and Training

D. Section 26 05 53 - Identification for Electrical Systems

E. Section 26 05 73 - Power System Studies

F. Section 26 05 75 - ShockHazard and Arc Flash Studies.

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

B. Reference Standards

1. NYCEC - Electrical Code of the City of New York.
2. UL 891 - Switchboards
3. UL 1008 - Transfer Switch Equipment
4. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
5. UL 1691 - Single-Pole Locking-Type Separable Connectors
6. NEMA ICS - Industrial Control and Systems General Requirements
7. NEMA ICS 5 - Industrial Control and Systems Control-Circuit and Pilot Devices
8. NEMA ICS 6 - Industrial Control and Systems Enclosures

1.05 DESCRIPTION

A. Generator quick-connect cabinet shall provide a safe, efficient, and reliable method to connect temporary emergency power from mobile generator to a facility in conjunction with a transfer switch or interlocked breakers and, where intended, shall provide a convenient way to connect load banks to a facility.

1.06 QUALITY ASSURANCE

A. Generator quick-connect cabinets shall be UL listed and labeled under UL 1008 and/or UL 891 standard.

B. Isolation circuit breakers shall be listed under UL 489.

C. Posi-Lok cable connectors shall be listed under UL 1691.

D. Industrial control circuits, pilot devices and enclosures shall comply with NEMA ICS, ICS 5, and ICS 6.

E. Generator quick-connect cabinet manufacturer shall provide complete factory assembled, wired, and tested generator quick-connect cabinets.

F. Generator quick-connect cabinet manufacturer shall submit applicable UL Certificate of Compliance.

G. Generator quick-connect cabinet shall be factory Hi-pot tested for a period of not less than 60 seconds.

H. Generator quick-connect cabinet manufacturing and installation shall meet all applicable NEC requirements as amended by the NYCEC.

1.07 SUBMITTALS

A. Shop Drawings

1. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

a. Manufacturer's catalog cuts, technical information, and enclosure details for the enclosed controllers.

B. Operations and Maintenance Manuals

1. Operations and Maintenance Manuals

a. Operation and Maintenance Manuals shall be submitted in accordance with the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Enclosed controllers shall be delivered, stored, and handled in accordance with the Contract Documents and the manufacturer's instructions

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for the enclosed controllers in accordance with this Section and the Contract Documents.

B. The spare parts shall be listed in an index and packed in containers suitable for long-term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. The following spare parts shall be furnished:

1. One (1) set of portable power cables, three phases, neutral and ground, multiple cables per phase to achieve ampere rating matching the quick-connect cabinet rating, with male Posi-Lok connectors on one end, and female Posi-Lok connectors on the other ends. Length of each cable shall be 50 feet. Connectors and cables shall be color-coded for three phases, neutral, and ground.

2. One (1) heavy-duty aluminum box with hinged padlockable cover, carrying handles and rollers for portability, designed for mounting securely on the back of a full-size pickup truck bed, and sized to contain the required portable power cables for mobile generator.

3. One (1) set of Posi-Lok connectors for three phases, neutral and ground, for both male and female connectors.

4. One (1) isolation circuit breaker of each size.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Generator Quick-Connect Cabinets shall be as manufactured by:

1. ASCO Power Technologies / Schneider Electric, Florham Park, NJ
2. Eaton Corporation, Beachwood, OH
3. PSI Power and Controls, Charlotte, NC
4. Trystar, Faribault, MN
5. ESL Power Systems, Corona, CA
6. Or approved equal.

B. Isolation circuit breakers shall be as manufactured by:

1. Schneider Electric, Florham Park, NJ
2. Eaton Corporation, Beachwood, OH
3. Siemens, Washington, DC
4. Or approved equal

C. Posi-Lok plugs and receptacles shall be as manufactured by:

1. Eaton Crouse-Hinds, Cleveland, OH
2. Or approved equal

D. Portable power cables for connecting mobile generators shall be as manufactured or assembled for this purpose by:

1. Southwire, Carrollton, GA
2. Allied Wire & Cable / Genuine Cable Group, Collegeville, PA
3. Eaton Crouse-Hinds, Cleveland, OH
4. Trystar, Faribault, MN
5. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. General

1. Quick Connect Input Power panels shall provide a convenient, reliable, and economical way to connect temporary emergency power from portable generators to a facility independent of or in conjunction with a transfer

switch or interlocked circuit breakers. Quick Connect Output Panels shall provide a convenient way to connect load banks to a generator.

2. The Quick Connect Power panels with Integrated Breakers shall be available in rating configurations from 400 Amp to 4000 Amp Service. Panels shall be listed to UL 891 or UL 1008. Actual ratings shall be as shown on the Contract Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Quick Connect Cabinets

1. Quick Connect Cabinets shall consist of (1) one molded case circuit breaker; Posi-Lok male connectors, power distribution block, and grounding terminals, all housed within a padlockable enclosure.

2. Quick Connect Cabinet enclosure shall be NEMA Type 4X waterproof and corrosion resistant, constructed of continuous seam-welded, type 316 stainless steel, suitable for exposed outdoor installation.

3. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female Posi-Lok plugs on one end and male Posi-Lok plugs on the other end shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened.

4. Cables shall enter and exit the wiring chamber via access holes specifically designed for conductors and shall be provided with a bushing or shall be formed so that there are no sharp edges with which conductor insulation may come in contact.

5. Connections shall be arranged so that cables drape downward when connected.

6. The quick connect panel enclosure dimensions as shown on the drawings. In locations where height is restricted, enclosure shall have two compartments with separate doors: right side for isolation circuit breaker and left side for generator cable connectors.

7. The quick connect panel shall include four (4) integral mounting tabs for wall mounting or mounting on independent post supports anchored on concrete pad.

B. Connectors

1. Number of male input cams shall not exceed the number as shown on the drawings and must be rated for the specified amperage.

2. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Posi-Lok male connectors shall be

color coded. Posi-Lok male connectors shall be provided for each phase and for ground and shall also be provided for neutral if required. Each of the phase Posi-Lok male connectors within the enclosure shall be factory-wired to a molded case circuit breaker.

3. The ground Posi-Lok male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor.

4. The neutral Posi-Lok male connectors, if required, shall be factory wired to a power distribution block.

5. None of the Posi-Lok male connectors shall be accessible unless the molded case circuit breaker is in the "OFF" position and the main access door is open.

C. Isolation Circuit Breaker

1. Molded case circuit breaker shall be UL Listed and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breaker shall be as shown on the drawings. Molded case circuit breaker shall include UL Listed door-mounted operating mechanism (with provisions for a locking device), preventing the opening of the main access door unless the breaker is in the "OFF" position. Molded case circuit breaker shall be mounted behind a deadfront panel. The molded case circuit breaker shall not be energizable unless the main access door is closed and the molded case circuit breaker is in the "ON" position.

2. Generator docking station shall be suitable for use as service equipment in the USA as defined by the NEC.

3. Generator docking stations shall include permanently affixed operation instructions.

D. Accessories

1. Phase Rotation Relay and indicating lights

2. Two-wire Auto Start Terminals

3. Auto Start Destination Switch

4. Lock and key mounted on exterior door. Restricts access to Portable generator connection unless key is captive and Square D Molded Case Isolation Breaker is open.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Each Quick-Connect Cabinet shall be completely assembled, wired, and tested at the factory, including all buses, connections, insulators, terminals, and terminal blocks, to demonstrate that it has been properly manufactured,

properly assembled, is not overheating, is not overloading, and has no electrical or mechanical defects.

2. Shop testing shall be performed on Quick-Connect Cabinets at the manufacturer's plant prior to shipment.

3. Shop tests shall be in accordance with the latest revisions of IEEE and NEMA and shall demonstrate that the equipment tested conforms to the requirements specified.

4. The Contractor shall provide a shop test report.

   a. The report shall identify the tests performed and the results obtained.

5. Quick-Connect Cabinet shop tests shall include the following:

   a. Visual and physical inspection of the interior and exterior of the Quick-Connect Cabinet, including all devices to verify consistency with approved submittals.

      1) Check bus layouts and takeoffs confirm with approved submittals.

      2) Check bus for proper electrical clearances.

      3) Check tightness of all bolted and torqued connections.

      4) Key interlock systems shall be tested to ensure operation as specified.

      5) Verify the polarity of all instrument transformers.

      6) Verify the grounding of all instrument transformers.

      7) Verify all nameplate engravings.

   b. Mechanical operations shall be performed to ensure proper functioning of operating mechanisms and interchangeability, and that all mechanisms are properly lubricated.

   c. Continuity tests shall be performed on power and control wires.

   d. Functional operations test, which shall include pick up, dropout, time delay, sequence and polarity.

   e. Primary hi-potential tests shall be performed.

      1) Primary current carrying parts shall be tested between phases, phase to ground, and line to load.

      2) The applied voltage shall be twice rated voltage plus 1000 for one minute.

   f. Hi-Potential tests on control and secondary wiring shall be performed.

      1) Control circuit wiring shall be tested for 1500 volts to ground for 1 minute or 1800 V for one second.

2) Power circuits shall be tested phase to phase and phase to ground at 2200 volt for one minute or 2700 volt for one second.

g. Verify connectivity and communication of devices to be connected to the Electrical Monitoring and Communication Systems (EMCS).

h. Simulated operation tests shall be performed to ensure the proper functioning of all controls, control circuits, control devices, and indicators inclusive of securing and returning all field connected inputs and outputs for each unit of the Quick-Connect Cabinet.

i. Verify the functioning of all meters, HMIs, communications devices, and channels.

B. Witness Shop Tests:

1. The Contractor shall perform witness shop tests in accordance with this Section, Section 01 43 15 – Witness Shop Testing and the manufacturer's procedures.

2. The Witnessed Shop Test shall not be scheduled before the approval of the Certified Shop Tests.

3. The tests shall be witnessed by the Engineer and DEP.

4. For the Witnessed Shop Test, the Contractor shall perform all the Certified Tests in the presence of the witnesses.

5. The Contractor shall obtain approval of the testing procedure, test station layout, instrumentation, and report of the Certified Test prior to scheduling the Witness Shop Test.

6. The Contractor shall submit and obtain approval by the Engineer, and the DEP electrical engineer of the Witness Shop Test report, before the Quick-Connect Cabinets are released for shipment.

a. The report shall identify the tests performed, the results obtained, contain all raw data sheets, certified test data, calibration certificates, punch lists, and confirmation as to how punch lists items were resolved.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Prior to installation of Quick-Connect Cabinets, Contractor shall examine the areas and conditions under which the Quick-Connect Cabinets are to be installed and notify the Engineer in writing if unsatisfactory conditions exist.

3.02 INSTALLATION

A. Equipment shall be mounted so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Equipment shall be securely fastened to walls or other surfaces on which they are mounted.

C. Independent supports shall be provided where no wall or other surface exists.

D. Quick connect cabinets shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code, and National Electrical Contractors Association's "Standard of Installation."

E. Conduit entry into the cabinets shall be by Contractor; Contractor shall furnish and install UL listed watertight conduit hubs, as manufactured by MYERS, T&B, or other, for each conduit entry on the generator quick connect cabinet. The incoming hub size shall match the conduit size for feeders and ground as shown on the Drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the Drawings.

F. Any conduit penetrations that are above live parts must be properly sealed to prevent moisture intrusion from the conduit. A UL Listed or Classified expanding foam sealant (such as Rainbow Quick Seal 79547), or other sealing product meeting local codes and NEC requirements, should be used to seal the interior of the conduit around the cables. The product selected must be able to permanently seal around all wires and the conduit (common 'Duct Seal" is not acceptable for this application). The sealing shall be done at the entry into the enclosure so the seal can be verified and inspected from inside the enclosure. Failure to seal may allow water to drip on live parts and will void warranty. Hubs shall be properly installed and tightened to maintain Type 4X integrity of the Quick-Connect Cabinets enclosure.

G. Contractor shall terminate feeder conductors, load conductors, and ground per the manufacturer's instructions. All field wiring terminations shall be torqued as required per the instructions on the Quick-Connect Cabinet's circuit breaker & ground lug.

H. Generator quick connect cabinets shall be installed in conformance with the NYCEC.

I. Identification

1. Identify field-installed conductors, interconnecting wiring, warning signs and components in accordance with Section 26 05 53 – Identification for Electrical Systems.

2. Label each cabinet and compartment with nameplates complying with Section 26 05 33 – Identification for Electrical Systems.

3. Provide device nameplates complying with Section 26 05 33 – Identification for Electrical Systems.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. After installation, the Quick-Connect Cabinets shall be field tested for operation and conformance.
2. Field testing shall conform to the requirements in this Section, Section 01 75 10 – Preliminary and Final Field Tests, NETA ATS, and the manufacturer's recommendations.
3. Field tests shall be witnessed by the Engineer and certified by the Contractor.
4. The services of the equipment manufacturer shall be retained for field testing.
5. Equipment testing shall be supervised by the manufacturer's representative, prior to energizing equipment.
6. Equipment shall not be energized without the permission of the Engineer.
7. Retain the service of an independent testing firm who shall perform field testing of the quick-connect cabinet.
8. The testing firm shall have experience in the inspection and testing of Quick-Connect Cabinets and shall be a member company of NETA.
    a. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

B. Preliminary Field Testing

1. Preliminary Field Test of the quick-connect cabinet shall be in accordance with the recommendations of the manufacturer's representative, NETA ATS, and shall consist at a minimum of the following:
2. Visual and physical inspections shall at a minimum verify the following:
    a. Verify all quick-connect cabinet equipment are located according to approved submittals.
    b. Verify all nameplates, tags, and identification marks in accordance with approved submittal and preliminary As Builts.
    c. Physical, electrical, and mechanical condition shall be inspected.
    d. Proper anchorage, required area clearances, physical damage, and proper alignment shall be checked.
    e. Ventilating air passageways shall be inspected for blockage.
    f. Mechanical interlock systems shall be checked for proper operation.
    g. Insulators shall be inspected for evidence of damage or contamination.

h. Device settings and adjustments shall be verified.

i. Breakers and vertical sections shall be checked to determine that they have been properly installed, lubricated, and connected.

j. Equipment shall be cleaned and lubricated as required.

3. Electrical testing shall at a minimum include:

a. Test continuity of all circuits

b. All connections shall be inspected for high resistance.

c. Electrical interlock systems shall be checked for proper operation.

d. Ground-resistance tests shall be performed.

e. Perform resistance measurements through bolted connections with a low-resistance measuring device.

f. Perform insulation-resistance measurements on each bus, phase-to-phase, and phase-to-ground for one minute.

g. An over potential test shall be performed on each bus, each phase-to-ground, and on each breaker in the closed position. Test each pole with other poles grounded.

h. Contact-resistance test shall be performed.

i. Control and metering wiring performance test shall be performed.

j. Primary and secondary voltage and current injections shall be performed to confirm phasing, polarities, and transformation ratios.

k. Circuit breaker trip characteristics shall be determined by primary current injection.

l. Control equipment and connections shall be checked to determine that they are not defective.

m. The settings of all protective and monitoring devices shall be confirmed with the full load current rating of the motors and those recommended by Section 26 05 73 – Power System Studies and Section 26 05 75 – ShockHazard and Arc Flash Studies.

C. Prior to energizing Quick-Connect Cabinet, the Contractor shall perform the following checks and tests as a minimum:

1. Verify mounting and connections are complete and secure.

2. Verify internal components and wiring are secure.

3. Perform continuity check of all circuits.

4. Perform 1,000 VDC megger test on feeder, load, and ground cables.

5. Confirm operation of the Quick-Connect Cabinets ground receptacle by attaching a plug to the Quick-Connect Cabinets ground receptacle and then verifying that the plug is grounded to the facility ground.

D. Quick-Connect Cabinet Final Field Test

1. Quick-Connect Cabinet Final Field Test shall be considered complete when all the outgoing circuits have energized their various loads for the Final Field Test of the respective load.

E. Any deficiencies or issues which may arise during Preliminary Field Tests, Preliminary Loading Test, or Final Field Test shall be remedied by the Contractor at no additional cost to DEP.

F. Manufacturer's Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the Quick-Connect Cabinet, check the Quick-Connect Cabinet installation before it is placed into operation, and assist in the performance of Preliminary and Final Field Tests.

2. The Manufacturer's representative shall provide Quick-Connect Cabinet equipment Start-up services and Training of the Contractor and the City's operations and maintenance staff in the care, operation, and maintenance of the Quick-Connect Cabinet in accordance with this Section, and the Contract Documents, and the following requirements:

a. Minimum number of manufacturer's representative Site visits per Quick-Connect Cabinet:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation Supervision	1	1	1
Installation Inspection	1	1	1
Field Testing	1	2	2
Startup	1	2	2
Training	1	1	1

b. Additional trips or days that are required to achieve the proper installation, operation, or training, shall be arranged for by the Contractor at no additional cost to DEP.

c. The Engineer shall have the right to reallocate any unused time

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

b. The Quick-Connect Cabinet manufacturer's representative shall certify in writing to the Engineer that the Quick-Connect Cabinet equipment has been installed, set up, and tested properly in accordance with Contract requirements and is operating at optimum conditions and capacity.

4. The manufacturer representative shall also make any necessary adjustments and instruct the Site personnel in its operation and maintenance.

5. The service representative shall sign in and out with the Engineer on each day they are at the Site.

6. A day shall be understood to be the actual time spent at Site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. Quick-Connect Cabinet Startup

1. Quick-connect cabinet Startup shall comply with the requirements of Section 01 79 05 – Equipment Start-up and Training and shall be considered completed when all the loads on the Quick-Connect Cabinet complete their startup requirements.

B. Training

1. The Contractor shall provide Training on the quick-connect cabinets in compliance with Section 01 79 05 – Equipment Start-up and Training

2. The Contractor shall submit for approval by the Engineer, lesson plans identifying in detail the training to be conducted.

3. The Contractor shall coordinate training services with the City and the Engineer.

4. The Contractor shall schedule training at least forty-five (45) days prior to delivery of training subject to the approval of the Engineer and the City.

5. The training shall consist of both classroom and field instruction.

6. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any control switches and other equipment required for operation, and to identify locations of any maintenance equipment.

7. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

8. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he/she is at the Project.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 33 53 – STATIC UNINTERRUPTIBLE POWER SUPPLY
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing uninterruptible power supplies (UPS). UPS shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The uninterruptible power supplies required under this Section shall be single or three-phase, continuous online, double conversion, solid-state types.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	12
3.01	Examination / Preparation	12
3.02	Installation	12
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	15

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. PWM – Pulse Width Modulated.
2. IGBT – Insulated Gate Bipolar Transistor

B. Reference Standards. UPS shall comply with the latest applicable provisions and recommendations of the following:

1.	ANSI C84.1	-	Electrical Power Systems and Equipment - Voltage Ratings
2.	IEEE C62.41	-	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
3.	IEEE C62.45	-	Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
4.	NETA ATS	-	NETA Acceptance Testing Specification.
5.	NYCEC	-	New York City Electrical Code
6.	UL 924	-	Emergency Lighting and Power Equipment
7.	UL 1449	-	Transient Voltage Surge Suppressors
8.	UL 1778	-	Uninterruptible Power Supply Equipment

1.05 DESCRIPTION

A. General

1. The UPS shall consist of convertor, an inverter, a precision float battery charger, a sealed, maintenance-free battery, and a bypass switch housed in self-contained compact package.
2. Each UPS shall provide the following operations:
   a. Under normal conditions the critical load shall be continuously supplied by the inverter.
      1) The inverter shall power the load while regulating both the voltage and the frequency.
      2) The convertor shall derive power from the AC source and shall supply DC power to the inverter. Simultaneously, the batteries shall be charged.
   b. When AC line power fails or goes out of tolerance, the battery source shall automatic supply the inverter via the DC link bus.
      1) There shall be no break in the output to the load, voltage or frequency during transfer from normal AC line supply to the battery supply or from the battery supply back to the AC line supply.
      2) Upon restoration of the AC supply, the battery charger shall automatically recommence charging the battery.

c. In the UPS position, the bypass switch shall connect the conditioned output to the load.

d. In the line position, the bypass switch shall cause the AC input line to be directly connected to the load.

e. Each UPS shall have active voltage regulation to enable the UPS to maintain its output voltage and frequency with varying input sources.

f. Each UPS shall be computer load compatible, suitable for the demands of computer type loads including power factor corrected, switch-mode, and linear power supplies.

g. Power ratings, nominal input, and output voltages, phases, and frequency shall be as shown on the Contract Drawings.

B. Operating Criteria:

1. The uninterruptible power supply's operating criteria shall be in accordance with the following:

a. Ambient temperature range - 0 degrees Celsius to 40 degrees Celsius.

b. Operational humidity – up to 95 percent non-condensing.

c. Maximum altitude - 3,000 feet above sea level

d. Altitude correction - 1-degree Celsius per 1,000 feet.

e. Voltage regulation - plus or minus 3 percent with input voltages plus fifteen to minus twenty percent of nominal.

f. Overload capability

g. 150 percent surge and 125 percent for 10 minutes operating on line

h. 150 percent surge and 110 percent on inverter.

i. Nominal frequency - 60 hertz

j. Adjustable tracking limits of .01 to 3 hertz.

k. THD – less than 5 percent at rated load.

l. Efficiency - 85 percent minimum.

C. Protection: The uninterruptible power supply shall have protective functions in accordance with the following.

1. Lightning and surge protection shall provide 2,000 to 1 spike attenuation.

2. Noise rejection shall provide common mode greater than 120 dB and normal mode greater than 60 dB.

3. Breakers shall provide over current protection for DC and battery charger circuits.

4. Remote emergency off shall shutdown the output supply to the load when activated from an external switch.

1.06 QUALITY ASSURANCE

A. General

1. The UPS shall be designed, built, and tested in accordance with the latest applicable editions of UL 1778.
2. The UPS shall be UL listed.
3. The UPS shall provide a reliable source of isolated, regulated, uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power.
4. The UPS manufacturer shall have 10 or more years of experience in the design and be regularly engaged in manufacturing and servicing equipment for installations of the type and size specified under this Section.
5. The UPS manufacturer shall use a shop test facility that has qualified and experienced technicians for all shop tests.

B. Field Tests:

1. The UPS shall be field tested.
2. Field testing shall be performed in accordance with the requirements specified under this Section.
3. Retain the services of the UPS manufacturer for field service.
4. Field service shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Name of the proposed manufacturer and location of closest service office from which this equipment shall be serviced and the location of closest parts inventory.
2. Manufacturer’s catalog cuts and technical information required to demonstrate compliance with the specific requirements, and to show all physical features and enclosure dimensions.
3. A completed materials list showing all items proposed for use.
4. Control and wiring diagrams with construction details of enclosures.
5. Single-line diagrams
6. Three-line diagrams.
7. Technical specifications.
8. Construction details of enclosures.

9. Description of shop and field testing methods, procedures, and apparatuses with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 90 days in advance prior to conformation of witness testing dates and actual testing.

10. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 90 days in advance to actual testing; five recent references with phone numbers shall be submitted.

11. Switchgear anchorage details with design calculations signed by licensed Professional Engineer, registered in the State of New York.

B. Certificates of Compliance:

1. Seismic qualification certification from the manufacturer, including mounting recommendations.

2. Cybersecurity Equipment Certification

3. Data and results of witness tests accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to Site shall proceed.

C. Reports:

1. Shop test and field test reports shall be submitted.

2. Manufacturer's Site visit and acceptance testing reports shall be submitted.

D. Operation and Maintenance:

1. Operation and Maintenance manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The UPS equipment shall be delivered, stored, and handled in accordance with this Section, the Contract Documents, and the manufacturer’s recommendations and the following:

1. UPS equipment shall be inspected for shipping damage or loose parts when received.

2. Evidence of water which may have entered equipment during transit shall be checked.

3. UPS equipment shall be lifted, rolled, or jacked into locations shown on the Contract Drawings.

4. UPS equipment shall be stored in a clean, dry location in which a uniform temperature is maintained.

5. UPS equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.

6. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for the UPS/s in accordance with the Contract Documents.

B. The spare parts shall be listed in an index and packed in containers suitable for long-term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. Spare parts shall be furnished and shall include one set for every four systems installed per power rating. Each spare part set shall consist of the manufacturer's complete line of recommended spare parts inventory and shall include at a minimum the following:

1. One set of fuses shall be provided of each size and type used.
2. One set of boards including interface, connection, fuse, display, driver, power supply with accessories shall be provided.
3. One set of modules including static switch assembly with accessories shall be provided.
4. One set of current monitor boards and contactor including convertor, inverter, I/O, and DC with accessories shall be provided.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. UPS/s shall be as manufactured by:

1. Schneider Electric;
2. Eaton Corporation;
3. Or approved equal.

B. Batteries shall be as manufactured by:

1. C&D Technologies Inc., Blue Bell, PA;
2. Schneider Electric;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. The UPS section shall comprise components organized in a modular manner to facilitate easy and ready replacement of components.

B. The mean time to repair any module shall be 30 minutes or less to return the UPS to its normal mode of operation.

C. Convertor module

1. The rectifier/charger shall convert the incoming AC power to a regulated DC output for supplying the inverter and for charging the battery.

2. The rectifier/charger shall be PWM design, using IGBTs.

3. The rectifier/charger module power factor under normal conditions shall be not less than 0.99.

4. The IGBTs shall feature protection circuitry that prevents the IBGTs from sourcing current in excess of their specified ratings.

D. Inverter module

1. The inverter shall comprise IBGT PWM design with high speed switching.

2. The inverter shall be capable of proving the required voltage and frequency while operating from the rectifier or the battery.

3. The IGBTs shall feature protection circuitry that prevents the IBGTs from sourcing current in excess of their specified ratings.

E. Static Bypass

1. The static bypass shall comprise fully rated, continuous-duty, naturally commutated static switches and facilitating high speed transfers.

2. The static bypass shall feature the following:

a. No break in output voltage and frequency.

b. Transfers complete in less than two cycles.

c. Transfers to bypass shall be automatically initiated for the following conditions:

1) Output overload beyond the setting period time out.

2) Bus voltage out of limits.

3) Internal over temperature setting period time out.

4) Battery approaching discharge

5) Convertor or invertor failure

d. Transfers to bypass shall be inhibited for the following conditions:

1) Bypass voltage out of limits

2) Bypass frequency out of limits

3) Bypass out of synchronization

4) Phase rotation error.

e. Uninterrupted automatic re-transfers shall take place whenever the inverter is capable of assuming the load.

f. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:

1) When transfer is manually initiated.

2) In the event of multiple transfer/retransfer cycles, the control circuit shall limit cycling to three cycles in any ten-minute period. At the end of the third transfer the control shall lock the load on bypass and initiate an alarm.

3) Convertor or invertor failure.

F. Batteries

1. Batteries shall be enclosed in the UPS cabinet or a separate cabinet when necessary.

2. Batteries shall be sealed maintenance free lead-calcium types.

3. Batteries shall be capable of maintaining the 110% of the rated load for two hours.

4. Batteries shall be capable of a minimum of 200 complete full load discharge cycles when operated and maintained within specifications.

5. A DC breaker shall provide protection for the batteries.

6. UPS shall be capable of monitoring and alarming an open DC breaker.

G. Controls and Indicators

1. Microprocessor controlled circuitry

a. Fully automatic control of the UPS shall be provided through the use of a microprocessor-controlled operating control system

b. Start-up and transfers shall be automatic functions, and shall not require operator intervention.

2. Front Panel Display

a. The UPS control panel shall be a touch sensitive, backlit, LCD front panel that includes LED indicators for basic UPS status. The LCD display shall at minimum have configured the following sections:

1) Home Screen

a) Show UPS status of output voltage, battery time remaining, and current alarms on all screens.

b) Show load level, average efficiency and power consumption in kW.

c) Show a system mimic diagram or menu showing power path, operating mode, and active events.

2) Control Section

a) Provide touch sensitive control buttons with confirming prompt, at minimum.

b) Turn UPS on or off.

c) Transfer to or from bypass.

d) Enable or disable the battery charger.

e) Initiate a battery test.

3) Metering Section

a) The metering section shall show voltages, currents, temperatures, kW, kVA and pf for the UPS input, output, and bypass.

4) Log Section

a) The log section shall show active alarms, alarm history, events, status changes, and commands.

b) The period interval at which information is displayed shall be adjustable.

5) Settings Section

a) The settings section shall permit the adjustment of all ranges and discrete data points of the UPS such as:

(1) Date and time

(2) Alarm designation

(3) Communications parameters

(4) UPS name

(5) Display language

(6) Passwords

3. Indicators

a. The colors for UPS alarm and event indicators shall be as follows:

1) Red – The power source is suppling power to the rectifier/charger and the inverter is powering the load.

2) Amber and Horn – An alarm condition has been detected.

3) Blue – The UPS has transferred and is in the bypass state.

4) Green – The power source has failed and the UPS battery is supplying the inverter which in turn is powering the load.

H. Interface Panel

1. A signal and communication interface panel located behind protective covers shall be provided and equipped with the following:

   a. 4 Form C dry contact capable of relaying alarm and status conditions either as NO or NC signals.

   b. Auxiliary contacts from the DC breaker

   c. One host USB connector.

   d. One device USB connector

   e. One RS 232 port

   f. One Modbus port

I. Enclosure

1. Enclosures shall be provided in accordance with NEMA requirements as follows:

   a. For dry, dusty locations, enclosures shall meet NEMA 12 requirements

   b. For wet and corrosive locations, enclosures shall meet NEMA 4X requirements.

   c. NEMA 4X enclosures shall be fabricated from 316 stainless steel

   d. For hazardous locations UPS power shall be fed through intrinsically safe barriers from non-hazardous locations.

2. UPSs shall be designed for forced air cooling.

3. Cooling air shall be drawn in through the front of the unit and exhausted through the top.

4. All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on each UPS at the manufacturer's plant prior to shipment.

2. Shop test shall be in accordance with the latest revisions of IEEE and ANSI, and shall demonstrate that the equipment tested conforms to the requirements specified.

3. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

4. UPS shop tests shall include the following:
   a. Physical inspection shall be performed including verification of tightness of all connections and connections of wiring harnesses to and from individual modules and boards.
   b. Functional tests which shall be the manufacturer's standard and include the following:
      1) Verification of the calibration of all UPS instrumentation
      2) Verification of all alarm and protections settings
      3) Verification of the operation of all modes of the UPS and the trouble free switchover from one mode to the next.
      4) A steady state load test verifying all input and output voltages, currents, frequency and balance among the phases at 0, 50 and 100% load.
      5) Monitoring current and voltage harmonics during the steady state load test and verification that harmonics are within stated limits.
      6) A transient load response test to verify voltage, current and frequency remain with specified limits when load acceptance and rejection is varied as follows
         a) 0% to 50% to 0%
         b) 25% to 75% to 25%
         c) 50% to 100% to 50%
      7) A battery-rundown test

B. Witnessed Shop Tests:
   1. The Contractor shall perform Witnessed Shop Tests in accordance with this Section and the Contract Documents.
   2. The Witnessed Shop Test shall not be scheduled before the approval of the Certified Shop Tests
   3. For the Witnessed Shop Test, the Contractor shall perform all of the Certified Tests in the presence of the witnesses.
   4. The Contractor shall provide a Shop Test Report. The report shall identify the tests performed and the results obtained.
   5. UPSs shall not be shipped before the approval of the Witnessed Shop Test Report.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. UPS equipment shall be installed in accordance with manufacturer's instructions and recommendations.

B. UPS equipment shall be installed so that sufficient access and working space is provided for ready and safe operation and maintenance.

C. UPS equipment shall be installed so that sufficient working space is provided to ensure adequate ventilation and cooling.

D. Where applicable, UPS equipment shall be installed on concrete pads at locations shown on the Contract Drawings.

E. Where applicable, steel channels shall be provided for support of UPS equipment.

F. UPS equipment shall be securely mounted to mounting surface/s with anchor bolts.

G. Anchor UPS to satisfy the specified seismic requirements in accordance with the anchorage details.

H. Install nameplates for identification of switchgear equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, UPS shall be field tested for operation and conformance.
2. The Contractor shall perform field tests in accordance with this Section and Contract Documents.
3. The field tests shall be witnessed by the Engineer and certified by the Contractor.
4. UPS testing shall be performed by the manufacturer's representative, prior to energizing equipment.
5. Equipment shall not be energized without the permission of the Engineer.
6. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall consist at a minimum of the following:
    a. Verification of the calibration of all UPS instrumentation
    b. Verification of all alarm and protections settings
    c. Verification of the operation of all modes of the UPS and the trouble free switchover from one mode to the next.
    d. A steady state load test verifying all input and output voltages, currents, frequency and balance among the phases at 0, 50 and 100% load.

e. Monitoring current and voltage harmonics during the steady state load test and verifying that harmonics are within stated limits.

f. A transient load response test to verify voltage, current, and frequency remain within specified limits when load acceptance and rejection is varied as follows

1) 0% to 50% to 0%

2) 25% to 75% to 25%

3) 50% to 100% to 50%

g. A battery-rundown test

7. Infrared testing shall be performed once after initial energization of the UPS, and a second time after full load has been applied continuously for (24) hours.

B. Manufacturer's Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the UPS, check the UPS installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations, and train the Contractor and the City's operations and maintenance staff in the care, operation, and maintenance of the UPS.

2. The Contractor shall provide UPS equipment start-up services and training in accordance with this Section, the Contract Documents, and the following requirements:

a. Minimum number of manufacturer's representative Site visits per UPS:

Construction Phase	No of Visits	Person-days per visit
Installation	1	1
Field Tests	1	1
Acceptance Tests	1	1
Training	1	1

3. Any additional time required to achieve a successful installation shall be at the expense of the Contractor.

4. The Engineer shall have the right to reallocate any unused person-days.

5. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site. The report shall include complete information on time, schedule, tasks performed, persons contacted,

problems corrected, tests results, training, instruction, and all other pertinent information.

6. The service representative shall sign in and out with the Engineer on each day they are at the Site. Person-days shall be understood to be the actual time spent at site and does not include travel to and from the Site.

3.04 STARTUP / DEMONSTRATION

A. The Contractor shall provide UPS start-up services and Training in accordance with this Section and the Contract Documents.

B. Acceptance Testing

1. The Contractor shall provide acceptance testing of the UPS.

2. All acceptance testing shall be performed by the testing firm, after the completion of the field tests specified under this Section.

3. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.

4. Acceptance testing inspection shall be performed on each UPS. Inspection shall include the following:

a. Physical, electrical, and mechanical condition shall be inspected.

b. Proper anchorage, required area clearances, physical damage, and proper alignment shall be checked.

c. Ventilating air passageways shall be inspected for blockage.

d. All connections shall be inspected for high resistance.

e. Electrical and mechanical interlock systems shall be checked for proper operation.

f. Insulators shall be inspected for evidence of damage or contamination.

g. Equipment shall be cleaned and lubricated as required.

5. Acceptance electrical testing shall be performed on each UPS. Facility load supplemented with load banks shall be used for the testing. Testing shall include the following:

a. Verification of the calibration of all UPS instrumentation

b. Verification of all alarm and protections settings

c. Verification of the operation of all modes of the UPS and the trouble free switchover from one mode to the next.

d. A steady state load test verifying all input and output voltages, currents, frequency and balance among the phases at 0, 50 and 100% load.

e. Monitoring current and voltage harmonics during the steady state load test and verify that harmonics are within stated limits.

f. A transient load response test to verify voltage, current, and frequency remain with specified limits when load acceptance and rejection is varied as follows

1) 0% to 50% to 0%

2) 25% to 75% to 25%

3) 50% to 100% to 50%

g. A battery-rundown test

h. Infrared testing shall be performed once after initial energization of the UPS and a second time after full load has been applied continuously for (24) hours.

6. All tests and values shall be in accordance with the manufacturer's recommendations and NETA ATS.

7. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA ATS.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCHES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing low-voltage open transition Automatic Transfer Switches (ATSs), including Bypass-Isolation Switches.

1. The Contractor shall provide all labor, materials, equipment, and incidentals, and is required to furnish and install ATSs, including Bypass-Isolation Switches, completely and operationally, as specified herein and as shown on the Contract Drawings.

2. Each ATS shall be provided in an enclosure.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	9
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 11 – General Electrical Requirements

B. Section 26 05 27 – Grounding

C. Section 25 05 29 – Hangers and Supports for Electrical Systems

D. Section 26 05 53 – Identification for Electrical Systems

E. Section 26 09 13 – Electrical Monitoring and Communication System

F. Section 40 61 93 – PMCS Input Output List

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems, and accessories intended for operation within the 600 Volt Class.

2. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the Local Electric Utility having jurisdiction.

B. Reference Standards: The ATSs shall comply with the latest applicable provisions and recommendations of the following:

1.	IEEE-446	-	Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
2.	ISO 9001	-	Quality management systems - Requirements
3.	NEMA ICS 10 Part 1	–	Electromechanical AC Transfer Switch Equipment
4.	NEMA ICS 10 Part 4	–	Guide to the Application of Low-Voltage Automatic Transfer Switch Equipment
5.	NFPA 110	–	Emergency and Standby Power Systems
6.	NYCEC	-	New York City Electrical Code
7.	UL 508	–	Industrial Control Equipment
8.	UL 1008	-	Transfer Switch Equipment

1.05 DESCRIPTION

A. ATSs shall be rated for the voltage, ampacity, and number of poles as shown on the Contract Drawings.

B. Switches shall have 600 volt insulation on all parts in accordance with NEMA standards.

C. The current rating shall be continuous when the switch is installed in a non-ventilated enclosure, and shall conform to NEMA temperature rise standards.

D. ATSs shall be rated based on all classes of loads, resistive, tungsten, ballast, and inductive loads.

E. ATs shall have a short circuit and withstand ratings as shown on the Contract Drawings and shall withstand the magnitude of fault current without welding of contacts.

F. ATSs shall include, but not be limited to the following:

1. ATS Mechanism permitting alternate connection to Source No. 1 or Source No. 2
2. Bypass-Isolation Switch permitting the complete isolation of the ATS mechanism from Source No. 1 or Source No. 2 and facilitating the continued powering of connected loads.
3. Control Panel
4. Enclosure

G. Source No. 1 and Source No. 2 shall be as shown on the Contract Drawings.

1.06 QUALITY ASSURANCE

A. ATSs shall comply with UL 1008, UL 508 and NEMA ICS 10.

B. The ATS manufacturer shall use a shop test facility for all factory tests that has a recently calibrated testing apparatus and qualified and experienced technicians.

1. Calibration of testing apparatus shall be within one year.

C. The ATSs shall be field tested.

1. Field testing shall be performed in accordance with the requirements specified under this Section.

D. The services of the ATS manufacturer shall be retained for field service.

1. Field service shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval by the Engineer.

B. Submittals shall include, but not be limited to:

1. The proposed manufacturer along with the location of its closest service facility from which the ATSs shall be serviced and location of closest parts inventory.
2. Manufacturer’s catalog cuts and technical information required to demonstrate compliance with the specific requirements.
3. A completed materials list showing all items proposed for use.
4. Control and wiring diagrams
5. Construction details of enclosures.

6. Description of shop and field-testing methods, procedures, and apparatus with calibration dates.

   a. Testing methods and procedures shall be submitted at least 60 days in advance prior to confirmation of witness testing dates and actual testing.

7. Qualifications of proposed testing firm to perform acceptance testing.

   a. Submit firm experience records and five (5) recent references with phone numbers at least 60 days in advance to actual testing.

C. Certificate of Compliance:

1. Seismic qualification certification from the manufacturer, including mounting recommendations.

2. Data and results of witness tests accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company.

D. Reports:

1. Shop test and field test reports.

2. Manufacturer's Site visit and acceptance testing reports.

E. Operation and Maintenance (O&M) Manuals

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver ATSs to ensure uninterrupted progress of the Work.

B. Releases of ATSs for shipment shall occur only upon approval of data and results of witness test reports.

C. Ship, handle, and protect ATSs in accordance with the Contract Documents..

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for ATSs.

B. The spare parts shall be listed in an index and packed in containers suitable for long-term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. Spare parts shall be as recommended by the manufacturer.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ATSs shall be as manufactured by:

1. ASCO, Florham Park, NJ
2. Russelectric, Hingham, MA.
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Power section:

1. The ATSs shall be an open transition switch of double throw construction whose operation in either direction shall be initiated by a reliable electrical mechanism that is momentarily energized and the switch mechanically held in its required position.
2. Designs are not acceptable which utilize components of molded-case breakers, contactors or parts thereof, and which are not intended for continuous duty, repetitive switching, or transfer between Source No. 1 and Source No. 2.
3. There shall be a direct mechanical coupling of Source No. 1 and Source No. 2 mechanisms to facilitate transfer switch operation in three cycles or less.
4. The Source No. 1 and Source No. 2 contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position or connection of both sources to the common load connection.
5. The mechanical interlocking shall be such that the switch is unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
6. The ATSs shall have sufficient arc-interrupting capabilities for 60 cycles of operation between Source No. 1 and Source No. 2, which are 120 degrees out of phase at rated voltage, 600% of rated current at 0.50 power factor to ensure that there will be no current flow between the two isolated sources during switching.
7. The contact structure shall consist of a main current carrying silver alloy contact, with a minimum of 50% silver content.
8. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes.
9. Inspection of all switch components shall be possible from the front of the switch without the disassembly of operating linkages and without the disconnection of power conductors.
10. Maintenance of all switch components shall also be possible from the front of the switch with access to all components.
11. A manual handle shall be provided for maintenance purposes. The handle shall permit an operator to manually stop the contacts at any point

throughout their entire travel to inspect and service the contacts when required.

12. For ATSs installed in systems having ground fault protective devices and wired so as to be designated as a separately derived system by the NYCEC, a fourth pole shall be provided. This additional pole shall isolate the Source No. 1 and Source No. 2 neutrals.

13. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients.

    a. Add-on or accessory poles that are not of identical construction and withstand capability of the phase poles are not acceptable.

14. The transfer switches shall have a minimum short circuit withstand rating as shown on the Contract Drawings or as required by short circuit studies, but not less than 100 kA symmetrical for ATS-A and ATS-B, and 40 kA symmetrical for ATS-C.

15. Terminal lugs shall be tin-plated copper.

B. Bypass-Isolation Switch

1. A double-throw bypass-isolation switch shall provide manual bypass of the load from either source and permit isolation of the automatic transfer switch from all sources and load power conductors. All main contacts shall be manually driven.

2. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door.

3. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts).

    a. The bypass handle shall have three operating modes: "Bypass to Source 1," "Automatic," and "Bypass to Source 2."

    b. The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated.

    c. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

4. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open."

    a. The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load.

b. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

5. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

C. Controls:

1. Solid State Control System

a. The control system for the ATS shall be solid state based and shall also contain all logic devices including control, voltage sensing, time delays and any auxiliary equipment required for to properly implement the functions detailed under this Section.

b. Control system shall have a programmable microprocessor controller with keypad and LCD display.

2. The panel shall be shielded and door mounted on the inside door of the switch enclosure.

3. All components shall be connected with a numbered wiring harness equipped with a disconnect plug that allows isolation of the control panel.

4. The solid state panel controls shall include adjustable three phase under voltage setting on each of the two sources to provide the following sequence of operation:

a. When the voltage of any phase of Source No. 1 is reduced to 80 percent of nominal voltage for a period of 1 second (fixed), the transfer switch shall be signaled to transfer to Source No. 2, after an adjustable time delay (0 -30 seconds).

b. The transfer switch shall remain in the Source No. 2 position indefinitely. Should any phase of the Source No. 2 source be reduced to less than 80 percent of nominal voltage for a period of 1 second (fixed), the transfer switch shall be signaled to transfer to Source No. 1, after an adjustable time delay (0 -30 seconds), if the Source No. 1 is available for operation.

c. The option of automatic transfer from Source No. 2 to Source No.1, as soon as Source No. 1 is available for operation shall also be provided

5. The transfer switches shall contain red indicating lights. The lights shall indicate switch position. The indicating lights shall be push-to-test, heavy-duty transformer LED type. Indicating light voltage shall be 12 Volts.

6. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible.

7. The transfer switches shall contain door mounted transfer/re-transfer pushbuttons. It shall allow an operator to switch from Source No.1 to Source No.2 and from Source No.2 to Source No.1. Transfer between sources shall be immediate.

8. The ATSs shall have all necessary accessories as required to transmit the status and alarm signals to a designated overall System Control Panel remote from the ATS. Signals are as specified in Section 40 61 93 – Input-Output List Tables and Section 26 09 13 – Electrical Monitoring and Communication System.

D. Auxiliary Power

1. Provisions for an external control power source to power the control panel when both sources are not available.

2. The takeoffs for external power sources shall be as shown on the Contract Drawings.

E. Enclosure:

1. The entire ATS shall be completely assembled within one enclosure. The enclosure shall be NEMA 12, painted gray, ANSI 61.

2. Terminal blocks shall be provided within the switch enclosure facilitate the connection of off enclosure signals and auxiliary power provisions.

a. Twenty percent spare terminals, two minimum, shall be provided.

b. Terminals shall be lettered or numbered to conform to the wiring diagrams.

3. The wires within automatic transfer switch shall be neatly harnessed to prevent the door damaging the wires and to prevent the wires hampering the door operation. All wires shall have identification markers on each end.

4. The enclosure shall be provided with a thermostatically controlled strip heater to keep humidity and temperature within acceptable levels.

5. The enclosure shall have identifying nameplates in accordance with the requirements of Section 26 05 53 – Identification for Electrical Systems.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting

1. The enclosure shall be painted gray, ANSI 61.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the ATSs at the manufacturer's plant prior to shipment.
2. Shop tests shall demonstrate that the equipment conforms to the requirements specified.
3. The tests shall include the manufacturer's standard tests and the following at a minimum.
    a. Operational tests to ensure proper operation of the components and sequence of operation.
    b. High potential test in accordance with NEMA standard.
4. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

B. Witness Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with the Contract Documents and this Section.
2. Witnessed Shop Test shall at a minimum repeat all of the Certified Tests in the presence of the Witnesses.
3. The Contractor shall provide a witnessed shop test report. The report shall identify the tests performed and the results obtained.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. ATSs shall be installed in accordance with Section 26 05 11– General Electrical Requirements, Section 26 05 29 – Hangers and Supports for Electrical Systems, this Section, and the manufacturer's instruction and recommendations.

B. ATSs shall be fully assembled with all required devices, wiring, nameplates, terminal blocks, and enclosures.

C. ATSs shall be rigidly and securely mounted to the building structure or to supporting devices, which are rigidly and securely supported to the building structure.

D. ATSs shall be installed with sides parallel or perpendicular to walls or equipment, in a neat and professional manner.

E. ATSs shall be installed such that door swing is not hampered.

F. ATSs shall be securely fastened in position with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work.

G. ATSs shall be grounded in accordance with Section 26 05 27 – Grounding, and NYCEC requirements.

H. Install nameplates for identification of equipment in accordance with Section 26 05 53 – Identification for Electrical Systems.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, ATSs shall be field tested for operation and conformance in presence of the Engineer.

2. The Contractor shall perform field testing in accordance with the Contract Documents, and as described in this Section.

3. ATS testing shall be performed by the manufacturer's representative, prior to energizing equipment. The testing shall be in accordance with the recommendations of the manufacturer and shall include the following at a minimum:

a. Mechanical and electrical components shall be inspected.

b. The switches shall be sequence operated to verify proper operation.

B. Manufacturer's Field Services

1. A qualified manufacturer's representative shall check the ATSs before it is placed into operation, assist in the performance of field tests, observe and assist initial operations, and train the plant operations and maintenance staff in the care, operation, and maintenance of the ATSs.

2. The Contractor shall provide equipment start-up services and training in accordance with the Contract Documents.

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction, and all other pertinent information.

4. The service representative shall sign in and sign out with the Engineer on each day they are at the Site.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 41 13 – LIGHTNING PROTECTION FOR STRUCTURES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing lightning protection of structures.

B. Lightning Protection Systems (LPS) for structures or buildings shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

C. The Contractor shall retain the services of a Certified LPS Installer.

D. The Certified LPS Installer shall furnish all labor, materials, equipment, services and incidentals necessary for the installation of a functional and complete LPS as specified herein.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 27 - Grounding

B. Section 26 43 13 - Low-Voltage Surge Protective Devices

1.04 REFERENCES

A. Definitions

1. Certified LPS Installer is a Subcontractor who is UL Master Labelled Certified Lightning Protection System Installer or Lightning Protection Institute Certified Installer.
2. Certificate of Inspection, where used in this Section, shall mean UL Lightning Protection Master Label Certificate.
3. Letter of Findings, where used in this Section, shall mean an official UL report detailing inspection of a LPS with intentional noncompliance due to construction or limitations of scope outlined by the installer that render an LPS ineligible for a UL Lightning Protection Master Label Certificate.
4. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation within the 600 Volt Class.
5. All references to the AHJ (Authority Having Jurisdiction) shall mean the NYCEC.
6. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the Local Electric Utility having jurisdiction.
7. LPI – Lightning Protection Institute.

B. Reference Standards

1. LPI 175 - Standard for the Design-Installation-Inspection of Lightning Protection Systems.
2. NFPA 780 - Standard for the Installation of Lightning Protection Systems
3. NYCEC - New York City Electrical Code.
4. UL 96 - Standard for Lightning Components.
5. UL 96A - Standard for Installation Requirements for Lightning Protection Systems.
6. UL 467 - Grounding and Bonding Equipment
7. UL 651 - Schedule 40, 80, Type EG and A Rigid PVC Conduit and Fittings.
8. UL LPS Guide - UL Marking and Application Guide – Lightning Protection.
9. ANSI/IEEE 141 - Recommended Practice for Electric Power Distribution for Industrial Plants.
10. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Installer

1. The LPS Installer shall be a Certified LPS Installer.
2. Provide proof of the certification, or demonstrate that the standards and experience required for certification are possessed, all to the satisfaction of the Engineer.

B. Materials

1. All materials shall be new and shall comply in weight, size and composition as required by UL 96A and NFPA 780 and for the structures or building to be protected.
2. Class I materials shall be used for systems on structures not exceeding 75 feet in height.
3. Class II materials shall be used for systems on structures exceeding 75 feet above grade.
4. All materials used in the installation shall be labeled or listed by UL for use in LPSs
5. All materials shall be of copper and high copper-content bronze castings or stainless steel.
6. LPS materials shall be selected to ensure that electrolytic or galvanic action does not occur at the contact points or surfaces.
7. Where dissimilar metals are in contact care must be taken to ensure that bimetallic connecting accessories are used and permit only similar metals to be in contact.

C. Certification of the Installation

1. The Engineer shall be given 96 hours notice of the intent to cover or conceal all parts of the LPS which will not be visible after completion and turn over of the installation.
2. The completed system shall be in accordance with UL 96A and NFPA 780 or LPI 175 but not both.
3. A Certificate of Inspection shall be provided for the completed LPS.
4. For installation areas, where a Certificate of Inspection is not available, a Letter of Finding shall be obtained.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer.

B. Submittals shall include, but not be limited to:

1. Qualifications of proposed Certified LPS Installer.

a. Submit experience records at least 45 days in advance to equipment submittals.

b. Five recent references with phone numbers shall be submitted.

2. Manufacturer's catalog cuts and technical information for the LPS materials proposed for use in this Contract.

a. Submittals shall demonstrate the mechanism that will be used to isolate dissimilar materials.

3. Scaled Shop Drawings showing proposed routing and layout of the LPS with installation details. Drawings shall include the stamp of the Certified Installer- Designer responsible for the system design.

4. Photographic and video documentation to show how the LPSs were installed in-ground and all concealed portions of the installation.

C. Certificates of Compliance:

1. Certificate of Inspection or Letter of Finding shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Lightning protection system materials shall be delivered, stored, and handled in accordance with the manufacturer's recommendations and this Section.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The lightning protection system shall be as manufactured by:

1. Heary Brothers Lightning Protection Company, Springville, NY.
2. Thompson Lightning Protection Company, West St Paul, MN.
3. East Coast Lightning Equipment, Winsted, CT.
4. Pentair Erico, Solon, OH
5. Harger, Grayslake, IL;
6. Or approved equal.

B. Non-metallic conduit and fittings shall be by as manufactured by:

1. Carlon (Thomas & Betts) - Memphis, TN.
2. Cantex Inc., Fort Worth, TX

3. Or approved equal.

C. Not Used

2.02 MATERIALS / EQUIPMENT

A. All materials used in the installation shall be new and shall comply in weight, size, and composition as required by UL 96A and NFPA 780

B. All lightning protection system fittings shall be heavy duty type.

C. All bolts, screws, and hardware shall be stainless steel.

D. Air Terminals and Accessories

1. Air terminals shall be not less than 18 inches long, not less than 5/8-inch in diameter, and may be manufactured in separate parts if longer than 10 inches.

2. Air terminals shall include a cast bronze point protector, stainless steel adapter, and copper base.

3. Air terminals shall be provided with an integral base support or shall have not less than five full threads of engagement with a separate attachment base mounted to the structure.

4. If the air terminal has internal threads the wall thickness shall be not less than 1/16 inch at the base of the threads.

5. Air terminals longer than 24 inches shall have bracing at half its height and listed for the purpose.

6. Air terminal bases are permitted to be stamped or cast construction.

a. Copper bases shall 0.061 minimum for copper material. If cast either copper or aluminum shall be at least 3/32 inches thick.

b. Air terminal base support must incorporate a connector fitting for connection of the lightning conductor.

1) The conductor contact area must be at least 1-1/2 inches on all sides of the cable.

E. Conductors

1. Class I

a. Main conductors shall be stranded copper conductors and shall be at least 57,400 circular mils at 187 lbs per 1000 ft.

b. Secondary or bonding conductors minimum size shall be 26,240 cir. mils for copper.

2. Class II

a. Main conductors; shall be not less than 115,000 cir. mils for copper conductor at 375 lbs per 1000 ft.

b. Secondary or bonding conductors minimum size shall be 26,240 cir. mils for copper.

F. Grounding Electrodes

1. Ground rod electrodes shall be stainless steel, a minimum 5/8” diameter and 10 feet long.
2. Ground rods shall conform to the requirements of Section 26 05 27 - Grounding.

G. Ground Cables:

1. Ground cables shall be copper. Approved means shall be provided to prevent dissimilar metal reaction.
2. Ground cable stranding, number and size shall be suitable for the classification of the structure to be protected.
3. All ground cable where exposed shall be corrosion resistant.

H. Non-metallic conduit shall be schedule 80 PVC plastic, 90 degrees Celsius rated, conforming to UL No. 651.

I. Non-metallic fittings shall be of same material and manufacturer as base conduit. Cement shall be provided for joining fittings to the conduit and shall be the same manufacturer as the base conduit.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Air Terminals and Air Terminal Accessories

1. Air terminals shall extend a minimum of ten inches above the object or area they are to protect.
2. Air terminals shall be located at intervals not exceeding 20’-0” along ridges of pitched roofs and along the perimeter of flat or gently sloping roofs (flat or gently sloping roofs include roofs that have a pitch less than 3:12).
3. Flat or gently sloping roofs exceeding 50’-0” in width shall be provided with additional air terminals located at intervals not exceeding 50’.
4. Air terminals shall be located within two feet of the ends of ridges, roof edges, and outside corners of protected areas.
5. Air terminals shall be installed on stacks, flues, mechanical units, and other objects not located within a zone of protection.

6. Permanent metal objects on the structure having an exposed metal thickness 3/16" or greater may be substituted for air terminals and shall connected to the lightning protection system as required by the specified standards using main size conductor and bonding plates having a minimum of 3 square inches of surface contact area.

7. Air terminal bases shall be securely fastened to the structure in accordance with the specified standards.

   a. Fasteners may include stainless steel screws, bolts, nails, or anchors.

   b. Adhesives shall only be used to complete other types of fasteners and shall be compatible with the fastener and structure material.

   c. Any protective sheets or pads that may be required by the roofing system manufacturer shall be furnished and installed by the Contractor.

8. Air terminal spacing exceeding these dimensions shall be permitted so long as the area protected lies within a zone of protection.

9. Air terminals shall be installed for stacks, flues, mechanical equipment, and other objects, having a metal thickness of less than 3/16 of an inch, and not located within a zone of protection.

   a. Permanent metal objects having a metal thickness 3/16 of an inch or greater shall be connected to the LPS in lieu of air terminals by main size conductors and bonding plates having a minimum of 3 square inches of surface contact area.

10. Flat or gently sloping roofs exceeding 50 feet in width, shall be protected with additional air terminals located at intervals not exceeding 50 feet in the flat or gently sloping area.

B. Conductors and Accessories

1. Conductors shall provide a two way, horizontal or downward path from each strike or air terminal to connections to the lightning protection ground electrode system.

2. Down conductors shall be sized as Class I or Class II materials in accordance with the specified standards.

   a. Down conductors where required as shown on the Contract Drawings shall be concealed in the exterior wall construction.

   b. Class II conductors from a higher portion of a structure shall continue to connections to the lightning protection ground electrode system.

   c. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure.

   d. In no case shall a structure have fewer than two down conductors.

   e. Where down conductors are installed exposed on the exterior of a structure and are subject to physical damage or displacement, guards

shall be used to protect the conductor a minimum of 6 feet above grade.

f. Metallic guards shall be bonded at each end.

3. In the case of structural steel frame construction, down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals averaging not more than 100 feet around the perimeter of the structure.

a. Connections to the steel frame shall be made with bonding plates having an area of a minimum of 8 square inches.

4. Conductors shall be installed free of excessive splices and sharp bends.

5. Conductor bends shall form an included angle of not less than 90 degrees nor have a radius of bend of less than 8 inches.

6. Conductors shall be secured to the structure at intervals not exceeding 3 feet.

a. Fasteners shall be of the same material or of a material equally resistant to corrosion as that of the conductor.

b. Any protective sheets or pads that may be required by the roofing system shall be furnished and installed by the Contractor.

7. Connector fittings shall be listed for the purpose and of the same material as the conductor or of electrolytically compatible materials.

C. Ground Electrodes and Accessories

1. Each down conductor shall terminate at a ground electrode dedicated to the LPS, or to a building or facility ground electrode system that consists of multiple ground electrodes that are interconnected with a ground ring conductor.

2. The down conductor shall be connected to the ground electrode by as exothermically welded connection.

3. Ground rod electrodes shall be located a minimum of 2 feet below grade and shall be installed below the frost line where possible (excluding shallow topsoil conditions).

4. Where it is not possible to drive ground rod electrodes because of bedrock or shallow topsoil conditions, ground plate electrodes, radial electrodes, ground ring electrodes, concrete- encased electrodes, or combinations of these may be used in accordance with NFPA 780.

5. Where the structural steel framework is utilized as down conductors for the system, ground electrodes shall be connected to columns around the perimeter of the structure at intervals averaging not more than 60 feet apart.

a. The grounding connection at the columns shall be made using either bonding plates having 8 square inches of surface contact area or by exothermically welded connections.

D. Common Bonding of Grounded Systems

1. Common bonding of all grounded systems within the building shall be ensured by interconnecting them to the LPS using main size conductor and fittings.
2. For structures exceeding 60 feet in height, the interconnection of the LPS ground electrodes and other grounded systems shall be in the form of a ground loop conductor.
3. These grounded systems to be interconnected shall include but are not limited to the electrical service, communication, and antenna system grounds as well as all underground metallic piping systems including water, gas, sewer, underground metallic conduits, etc.
4. Interconnection to service lines or conduits shall be made on the customer's side of the meter.
5. Ground Electrodes in test wells shall be bonded to the ground system by a bronze ground rod clamp having at least 1-1/2 inches of contact between the rod and the conductor, measured parallel to the axis of the rod.
6. The system shall be installed with common grounding by interconnecting ground mediums entering the building using main size conductors and fittings. Grounded metal bodies shall be bonded to the system using bonding connections and fittings. Ground conductors where installed in conduit, shall be non - metallic type.

E. Potential Equalization

1. Grounded metal bodies located within the required bonding distance as determined by the bonding distance formula in NFPA780 shall be bonded to the LPS using the required bonding conductors and connections.

F. Roof Penetrations

1. Roof penetrations required for down conductors or for connection to structural steel framework shall be made using thru-roof assemblies with solid riser bars or conduits and appropriate roof flashing.
2. Conductors shall not pass directly through the roof.
    a. The Contractor shall furnish and install the materials required to properly seal all roof penetrations of the LPS components and any additional roofing materials or preparations required by the roofing manufacturer for lightning conductor runs to assure compatibility with the warranty for the roof including roof pads that may be required to protect the roof under each of the lightning protection components.

G. Surge Protective Devices (SPD)

1. SPDs shall be provided at all power services entrances and at entrances of conductive signal and data communication devices.
2. SPDs shall comply with Section 26 43 13 – Low-Voltage Surge Protective Devices.

3.03 FIELD TESTING / QUALITY CONTROL

A. The Contractor shall have the master installer or inspector perform field inspection of the lightning protection system at several stages during the installation in accordance with LPI requirements.

B. Upon completion of the lightning protection system the Contractor shall arrange for a final inspection of the system. The final inspection shall be performed by the master installer or inspector in accordance with LPI requirements.

C. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 26 43 13 – LOW- VOLTAGE SURGE PROTECTIVE DEVICES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing surge protective devices (SPDs).

B. SPDs shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

C. SPDs shall utilized to limit repetitive transient voltage and current surges in low-voltage AC power circuits.

D. The Contractor shall furnish all labor, materials, equipment, services and incidentals necessary for the installation of the SPDs as specified herein.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Definitions

1. Low-voltage as used in this Section and the Contract Documents shall mean all equipment, conductors, insulation systems and accessories intended for operation within the 600 Volt Class.

2. All references to the AHJ (Authority Having Jurisdiction) shall be as set out in the NYCEC.

3. All references to the Electric Utility or Utility shall mean Consolidated Edison Company or the Local Electric Utility having jurisdiction.

B. Reference Standards

1.	ANSI/IEEE C84.1	–	Electric Power Systems and Equipment – Voltage Ranges (60 Hertz).
2.	ANSI/IEEE 141	-	Recommended Practice for Electric Power Distribution for Industrial Plants.
3.	IEEE 1100	-	Recommended Practice for Powering and Grounding Electronic Equipment.
4.	IEEE C62.41	-	Recommended Practice on Surge Voltages In Low-Voltage AC Power Circuits.
5.	IEEE C62.45	-	Recommended Practice On Surge Testing For Equipment Connected to Low-Voltage AC Power Circuits.
6.	IEEE C62.62	-	Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low-Voltage (1000 V and Less) AC Power Circuits.
7.	IEEE C62.72	-	Guide for the Application of Surge Protective Devices for Low Voltage AC Power Circuits.
8.	UL 1012	-	Power Units Other Than Class 2.
9.	UL 1283	-	Electromagnetic Interference Filters
10.	UL 1449	-	Surge Protective Devices 4th Edition or later.
11.	NYCEC	-	Electrical Code of the City of New York.

1.05 DESCRIPTION

A. SPDs shall be Type 1, 2 or 3.as defined by UL 1449.

1. Type 1 SPDs shall be

a. Permanently connected and intended for installation between the secondary of the service transformer and the line side of service equipment.

b. Installed without use of external overcurrent protective device.

2. Type 2 SPDs shall be

a. Permanently connected and intended for installation on the load side of the service equipment overcurrent device.

3. Type 3 SPDs shall be

a. Permanently installed at the point of utilization.

b. Installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel.

c. Not used at the utilization point if the distance criteria of a. and b. above cannot be satisfied.

1.06 QUALITY ASSURANCE

A. SPDs shall be designed, built and tested in accordance with the latest applicable editions of NEMA, ANSI/IEEE, UL and NFPA.

B. SPDs shall be UL listed.

C. SPDs of the types and ratings required are of those acceptable manufacturers who have been regularly engaged in the development, design, testing, listing, manufacture and servicing of SPDs for a period of ten years or more and whose products have been in satisfactory use for 10 years or more.

D. SPD manufacturers shall maintain a documented Quality Assurance Program implementing suitable procedures and controls to monitor all aspects of production and testing.

E. The Quality Assurance Program shall be the manufacturer's standard program specifically dedicated to ensure each SPD is designed, assembled and tested in accordance with the requirements specified herein.

F. Testing shall be done in accordance with UL 1449 on the complete SPDs with lead length comparable to that which will be required to connect the SPDs to the equipment to be protected and as shown on the Contract Drawings.

G. Only qualified personnel or licensed electricians shall actually install SPDs.

H. The Contractor shall retain the services of the SPD manufacturer for field service.

I. Field service shall be in accordance with the requirements specified under this Section and the Contract Documents.

1.07 SUBMITTALS

A. Contractor shall submit working drawings, Shop Drawings and material specifications for the approval of the Engineer.

1. Upon request, suppliers or manufacturers shall provide a list of not less than three (3) customer references showing satisfactory installation and operation.
2. Catalog cuts indicating selected ratings and mechanical drawings of SPDs, shall be submitted for approval by the Engineer.
3. Submittals shall contain the required published device specifications and Drawings to show conformance with all parts of this Section.
4. Instructions for installation and connection shall be provided with the SPDs.
5. All Let-Through voltage data shall be measured on an "As Installed" lead length basis, simulating actual installation. At the module or at the bus "Zero lead length" data is not acceptable.
6. Copy of the ISO 9001:1994 Certificate of Registration will accompany the submittal.
7. The connection lead length from the SPD enclosure to the connection point of protected circuit must be detailed in the submitted documentation.

B. Report Submittals:

1. Surge Protective Device (SPD) shop test reports shall include test data verifying let-through voltage, surge current rating and noise attenuation.
2. Manufacturer’s field report
3. Surge Life (Repetitive Surge) rating
4. Maximum Continuous Operating Voltage (MCOV) rating
5. Voltage Protection Ratings for all modes (VPR)
6. Nominal Discharge Current (In)

C. Operation and Maintenance (O&M) manuals shall be submitted for approval.

1.08 DELIVERY, STORAGE, AND HANDLING

A. SPDs shall be delivered, stored and handled in accordance with the Contract Documents and the manufacturer’s recommendations.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. SPDs shall be as manufactured by:

1. Schneider, Seneca, SC;
2. Siemens, Washington, DC;
3. ABB, New Berlin WI;
4. Eaton Corporation;
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Electrical Requirements

1. The SPD operating voltage and configuration shall be as shown on the Contract Drawings.
2. The Maximum Continuous Operating Voltage (MCOV) shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels.
    a. Each thermally protected MOV shall have an end of life indicator and the suppression system shall be continuously self-monitoring.
    b. End of life mode to be open circuit.
    c. SPDs with end of life short-circuit mode are not acceptable.
    d. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. SPDs must not require external OCPD or replaceable internal OCPD for the UL Listing.
5. The SPD must protect all modes of the electrical system being utilized, i.e. Normal (L-L, L-N) & Common (N-G, L-G).
6. The Nominal Discharge Current (I_n) for all SPDS shall not be less 20 kA regardless of Type.
7. The Voltage Protection Rating (VPR) of the SPDs shall not exceed the following:

Mode	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. Features

1. Balanced Suppression Platform

   a. Surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance.

   b. The surge suppression platform must provide equal impedance paths to each matched MOV.

   c. SPDs containing items such as single-mode replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted.

2. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

3. Each thermally protected MOV shall have an end of useful life indicator and the suppression system shall be continuously self-monitoring.

4. SPDs with removable covers or doors shall be equipped with internal safety barriers having lockout provisions to prevent contact with energized components.

5. Internal Connections

   a. No plug-in single-mode modules or printed circuit boards shall be used as surge current conductors.

   b. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

6. Electrical Noise Filter

   a. Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter.

   b. Noise attenuation for electric line noise shall be [50 dB] or [40 dB] minimum from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable to meet this specification shall not be accepted.

   c. Type 2 units with filtering shall be co-listed to UL 1283 5th Edition or later.

   d. Type 1 units shall not contain filtering nor can they have a UL 1283 5th Edition Listing.

7. Monitoring and Diagnostics

   a. Protection Status Indicator

      1) Each SPD shall have a green/red solid-state indicator lights that reports the status of the protection on each phase.

a) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes.

b) Wye configured units shall also contain solid-state indicator lights that report the status of the protection elements and circuitry in the N-G mode.

c) SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

d) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

e) The absence of a green light and the presence of a red/yellow light shall indicate that damage has occurred on the respective phase or mode.

f) All protection status indicators must indicate the actual status of the protection on each phase or mode.

g) If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes.

h) Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor

1) SPDs, where shown on the Contract Drawings, must include Form C dry contacts (one NO and one NC) for remote annunciation of SPD status.

2) Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm

1) SPDs shall contain an audible alarm that will be activated under any fault condition.

2) There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter

1) SPDs shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location.

2) The surge counter shall register a count for each surge event clamped by the SPD.

3) A reset pushbutton shall also be standard, allowing the surge counter to be zeroed.

4) In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

5) If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored.

6) The surge counter's memory shall not require a backup battery in order to achieve this functionality.

8. MOV Protection

a. SPDs shall contain thermally protected MOVs.

b. The self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV.

c. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

d. Each thermally protected MOV shall have an end of useful life indicator and the suppression system shall be continuously self-monitoring.

9. Overcurrent Protection

a. The unit shall not require external overcurrent protective device (OCPD) as part of the UL 1449 listing.

b. If the AHJ requires overcurrent protection of the conductors connecting the SPD to the system then OCPD shall be sized based on governing AHJ electrical code requirements.

10. Fully Integrated Component Design

a. All of the SPD's components and diagnostics shall be contained within one discrete assembly.

b. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

11. Safety Requirements

a. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable/replaceable parts and shall not require periodic maintenance.

b. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted.

c. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device can pose a safety hazard and shall not be accepted.

d. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit or shall have barriers that block access to harmful voltages.

e. Lockout provisions, capable of accepting a padlock, shall be provided on units with a disconnecting internal breaker if applicable.

f. SPDs without barriers or lockout provisions shall be factory sealed to reduce exposure to harmful voltages.

g. Factory sealed units shall have installed phase, neutral, ground and remote status contact conductors and shall have a pigtail set of conductors protruding outside of the enclosure for field installation.

12. The manufacturer shall certify that all materials and processes used as a component of the SPD units, and used in the process of manufacturing and packaging of the units are in accordance with The Federal Clean Air Act Amendments of 1990, Sections 602 and 611, prohibiting the use of Class I or Class II ozone depleting chemicals.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. SPDs shall have either NEMA 1, NEMA 4, or NEMA 4X stainless steel enclosures suitable for locations indicated on the drawings and as described below:

1. NEMA 1

a. Constructed of ANSI 61 painted steel.

2. NEMA 4

a. Constructed of ANSI 61 painted .

3. NEMA 4X

a. Constructed of 316 stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection.

4. NEMA 4X

a. Constructed of polycarbonate providing the same level of protection as the NEMA 4 enclosure.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the SPD at the manufacturer's plant prior to shipment.
2. Shop tests shall include the manufacturer's standard tests and shall demonstrate quality assurance inspection and testing procedures for the equipment.
3. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. SPDs of the appropriate listing shall be installed at locations shown on the Contract Drawings

B. Installation locations shall include Service Entrance Equipment, Distribution Equipment and Utilization Equipment.

C. SPD installations shall confirm to the manufacturer's written instructions and recognized installation practices including:

1. Proximity to the protected equipment
2. Strict adherence to the total length of conductors feeding the SPD.
3. Minimum bend radius of feed conductors.
4. Maximum number of bends in the feed conductors.
5. Whether the grounded conductor is to be bonded at the SPD.
6. Grounding of both the SPD and the protected equipment.

D. The SPD manufacturer shall make available experienced, qualified, power-quality application and field supervision engineering services during installation and start-up.

E. The Contractor shall verify the proper application of the SPDs (i.e. voltage, phase, etc.) and coordinate with upstream and downstream SPDs.

F. The Contractor shall assure that all neutral conductors are bonded to the system ground at the service entrance or at separately derived system point, prior to installation of the associated SPDs.

G. Install nameplates for identification of equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. Manufacturer's Representative

1. A qualified representative from the SPD manufacturer shall assist in the installation of the SPDs, check the installation before it is placed into operation, observe and assist initial operations and train operations and maintenance staff in the care, operation and maintenance of the SPDs.
2. The service representative shall sign in with the Engineer on each day they are at the Site.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 51 11 – LIGHTING FIXTURES, DEVICES AND SCHEDULES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing lighting fixtures (luminaires) and devices. Luminaires and devices shall be provided in accordance with the requirements specified under this Section and the Contract Documents.

B. The lighting system shall be complete and include all equipment, devices and accessories as required for the installation of the luminaires and devices.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	11
2.04	Source Quality Control / Shop Tests	11
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 33 - Raceways and Boxes for Electrical Systems

B. Section 26 05 53 - Identification for Electrical Systems

1.04 REFERENCES

A. Luminaires and devices shall comply with the latest applicable provisions and recommendations of the following even if not specifically listed in this Section:

1.	ANSI C78.377	-	Specifications for the Chromaticity of Solid-State Lighting (SSL) Products
2.	DLC PR	-	DesignLights Consortium Premium Technical Requirements
3.	EISA 2007	-	Energy Independence and Security Act of 2007
4.	IES LM-79	-	Approved Method: Electrical and Photometric Measurements of Sold State Lighting Products
5.	IES LM-80	-	Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
6.	IES TM-21	-	Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources
7.	NEMA SSL-1	-	Electronic Drivers for LED Devices, Arrays, or Systems.
8.	NYCEC	-	New York City Electrical Code.
9.	NYCECC	-	New York City Energy Conservation Code
10.	UL 20	-	General Use Snap Switches.
11.	UL 844	-	Electric Lighting Fixtures for Use in Hazardous Locations.
12.	UL 894	-	Switches for Use in Hazardous Locations.
13.	UL 924	-	Emergency Lighting and Power Equipment.
14.	UL 1010	-	Electrical Receptacle - Plug Combinations for Use in Hazardous Locations.
15.	UL 1029	-	High Intensity Discharge Lamp Ballasts.
16.	UL 1572	-	High Intensity Discharge Lighting Fixtures.
17.	UL 1598	-	Luminaires
18.	UL 8750	-	Light Emitting Diode (LED) Equipment for Use in Lighting Products.

19. CBM - Certified Ballast Manufacturers, CBM.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General:

1. Luminaires shall be UL listed, approved for use in the City of New York and comply with NYCECC.

2. The luminaire types are noted within the fixture schedule which is shown in this Section. The descriptions and catalog numbers serve to establish the quality, appearance and performance of the specified luminaires.

3. Luminaires and controls shall be as manufactured by the same manufacturer.

4. All luminaires shall be the products of lighting equipment manufacturers who have previously demonstrated, by performance and reputation, the ability to manufacture products of the quality specified and shall have a minimum of 5 years' experience manufacturing the luminaires specified. Such manufacturers must maintain an organization and manufacturing facility capable of actually manufacturing the specified luminaires. For the purpose of inspection, Contractor shall assure the Engineer, free and easy access to the manufacturing facilities and inventories of any manufacturer whose equipment the Contractor proposes to supply.

5. Luminaries over the range of operating voltage and temperature shall comply with the following:

   a. Minimum power factor of 0.95

   b. THD for both current and voltage of less than 10%

6. Luminaries shall have integral UL Listed Class 2 drivers and ballasts.

7. Luminaires shall have integral surge protective devices (SPD) to protect the luminaire from common mode transient peak voltages and transient peak currents.

8. Luminaires shall comply with DLC PR.

9. Luminaires utilizing incandescent sources are not permitted.

10. Luminaires shall utilize electronic or solid state drivers or ballasts where applicable.

11. The Contractor shall be responsible to assure that the exact inscription for exit and stairway signs required by local code is checked against that specified, prior to providing same. The Engineer shall be advised of any changes required to conform to local codes before such changes are effected.

12. The Contractor shall be responsible for reviewing all Contract Drawings and coordinating with all trades the installation of luminaires and devices. Luminaire and device finishes and construction shall be compatible with the approved wall and ceiling types which shall be determined by the Contractor's review of all Contract Drawings.

13. All luminaires shall be of the highest quality material and construction for their respective types.

14. Lamps for all luminaires shall be in accordance with EISA 2007.

15. Luminaires shall be suitable for connection to concealed or exposed conduit runs as required in each particular location and shall be of sizes suitable for lamp sizes indicated on the Contract Drawings.

16. Fittings and other materials for special luminaires not definitely shown or specified shall be of approved material, make and quality and shall have a finish that will harmonize with other parts of the luminaires. Where suitable standard materials are not available such parts of the luminaires shall be specially manufactured.

B. Field Testing:

1. Luminaires shall be field tested. The field testing shall be performed in accordance with the requirements specified under this Section.

2. Retain the services of the emergency inverter system manufacturer for field services. Field service shall be in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. A list of proposed manufacturers with the products they produce proposed for the contract.

2. Manufacturer's catalog cuts and drawings showing all technical information, and construction details for luminaires, including dimensions, type of wiring, weight, size, installation methods, provisions for relamping or replacing luminaires from the ground, test information criteria and rated life in hours with corresponding standard.

3. Photometric data, developed for each fixture type.

4. Lamp type and technical information.

5. Ballast type and technical information.

6. Driver type for LED luminaires and technical information including input voltage, power factor, Crest Factor and THD.

7. Scaled Shop drawings showing the locations of all fixtures and devices. The Drawings shall include the proposed routing of the branch circuits.

B. Reports

1. Field test reports shall be submitted.

2. Manufacturer's site visit report shall be submitted.

C. Operations and Maintenance Manuals

1. Operations and Maintenance Manuals shall be submitted in accordance with this Section and the Contract Documents.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Luminaires and devices shall be delivered, stored and handled in accordance with this Section, the Contract Documents, and the manufacturer's instructions.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the Site and at such time as the Engineer may direct, spare parts for luminaires and devices in accordance with this Section and the Contract Documents.

B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. The following spare parts shall be furnished:

1. 10 percent lamps, lamp module or array shall be provided of each wattage of each type of lamp, lamp module or array but not less than the requirement for two luminaires.

2. Where the lamp, lamp module or array is an integral part of the luminaire and the lamp, lamp module or array is not normally replaceable provide spare luminaires instead.

3. 5 percent ballasts or drivers shall be provided of each type of type of ballast or driver, but not less than two.

4. 5 percent total fuses for each luminaire type and size but not less than one set for each size.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lamps shall be as manufactured by:

1. Cree, Durham, NC;

2. Nichia America Corporation, Wixom, WI;
3. GE Lighting, Cleveland, OH;
4. Osram Sylvania, Wilmington, MA;
5. Or approved equal.

B. Drivers and Ballasts shall be as manufactured by:
1. Osram Sylvania, Wilmington, MA;
2. Universal Lighting Technologies Inc., Nashville, TN;
3. Eldo LED, Conyers, GA;
4. Advance Transformer, Rosemont, IL;
5. Or approved equal.

C. Emergency inverter systems shall be as manufactured by:
1. Vertiv-Emerson Network Power, Houston, Texas;
2. Emergi-Lite;
3. Or approved equal.

D. General use receptacles shall be as manufactured by:
1. Hubbel Incorporated, Shelton, CT;
2. Arrow-Hart Incorporated, Chicago, IL;
3. Or approved equal.

E. Hazardous location receptacles and 480 volt receptacles shall be as manufactured by:
1. Crouse-Hinds Company, Syracuse, NY;
2. Appleton Electric Company, Rosemont, IL;
3. Or approved equal.

F. General use switches shall be as manufactured by:
1. Hubbel Incorporated, Shelton, CT;
2. Arrow-Hart Incorporated, Chicago, IL;
3. Or approved equal.

G. Hazardous location switches shall be as manufactured by:
1. Crouse-Hinds Company, Syracuse, NY;
2. Appleton Electric Company, Rosemont, IL;
3. Or approved equal.

H. Plates shall be as manufactured by:
1. Hubbel Incorporated, Shelton, CT;

2. Arrow-Hart Incorporated, Chicago, IL;

3. Or approved equal.

I. Covers shall be as manufactured by:

1. Crouse-Hinds Company, Syracuse, NY;

2. Appleton Electric Company, Rosemont, IL;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Luminaires

1. A luminaire shall be provided for each luminaire symbol shown on the Contract Drawings.

2. Luminaires shall be provided with all necessary hangers, supports, conduit adaptors, reducers, hooks, brackets and other support hardware. All hardware shall have a protective, non-corrosive finish.

3. Recessed luminaires shall be provided with trim moldings and frames suitable for the types of ceilings.

4. Pendent mounted luminaires shall be suspended by means of an enclosed and gasketed cushion type hanger. The hanger shall be suitable to be mounted directly to the luminaire outlet box and shall provide a minimum of 8 degrees swing from the vertical. Stems shall be threaded rigid metal conduit, 1/2 inch minimum size. In corrosive areas stems shall be PVC coated.

5. Where luminaires are subjected to moisture, or assembled of dissimilar metals, gaskets of approved material and thickness shall be provided.

6. Explosion-proof type luminaires shall comply with the requirements of the NYCEC for the hazardous locations indicated on the Contract Drawings.

7. Luminaires shall be completely wired except where they will be directly connected to branch circuit wiring. The conductors shall be not less than No. 12 gauge, stranded, with approved heat resistant covering.

8. Mounting heights of all luminaires shall be as shown on the Contract Drawings. For special types, the height shall be determined at the time of installation.

B. Lamps

1. Lamps in association with their ballasts or drivers shall have voltage ratings suitable for the voltages shown on the Contract Drawings.

2. The color temperature of lamps shall be such that the installed luminaire color temperature is as listed in this Section or shown on the Contract Drawings.

3. LED lamps shall be in accordance with the following:

a. Comply with UL 8750

b. CRI of not less than 85

c. Minimum efficacy of 140 lumens/watt

d. Lamp L80 life of not less than 100,000 hours at 25 degrees Celsius

e. Maximum junction temperature of 150 degrees Celsius

f. Binning per ANSI C78.377 at 85 degrees Celsius

g. Very low thermal resistance to permit optimum heat transfer from the junction to the operating ambient.

C. Drivers and Ballasts

1. General:

a. Ballasts and Drivers shall be matched for proper operation of lamps and shall meet the requirements for luminaire light output, reliable starting and operation.

b. Ballasts and Drivers shall have dimming capabilities and the lamps shall be corresponding suitable for dimming. Dimming requirements shall be listed in this Section or as shown on the Contract Drawings.

c. Ballasts shall be UL listed and certified by approved Nationally Recognized Testing Laboratories (NRTL). Testing Laboratories and shall conform to CBM.

2. LED Drivers

a. LED drivers shall be matched to their lamps such that the luminaire supply voltage and its likely site variations shall produce a level of performance indicated in this Section and as shown on the Contract Drawings

b. LED Drivers in conjunction with the respective luminaire construction shall achieve the following:

1) Specified lumen output with variation from specified voltage of plus or minus 10%.

2) Rated life of not less than 100,000 hours.

3) THD of less than 10% across the specified voltage range and full power.

4) Power factor of not less than 95% and over the full range if dimming specified.

5) Consistent performance over the range of temperatures expected at the installation location either indoors or outdoors.

6) Cooling shall be achieved with static arrangements. Active cooling, thermal foldback or thermal sensing to achieve temperature control are not permitted.

c. Electrical connections between LED Drivers and all components of the luminaire shall be polarized and color coded to permit trouble free connection and reconnection. A connection diagram shall be imprinted on the Driver or the internal of the luminaire.

3. Lighting Contactor Panels

a. Lighting contactor panels shall be provided for the control of luminaires where specifically indicated on the Contract Drawings. The panel control and devices shall be arranged for proper operation in accordance with the control schematics shown on the Contract Drawings.

b. The panel enclosures shall be steel, single door type. Enclosures shall be NEMA 12 for dry, indoor areas and NEMA 4X for corrosive areas. Each enclosure shall be equipped with a control fuse with mounting block and 300 volt screw type terminal blocks.

c. Contactors shall be mechanically held type suitable for 120 volt operation and switching ballast type lighting. Contactor voltage, ampere, number of poles and quantities within each panel shall be as shown on the Contract Drawings.

d. Where indicated on the Contract Drawings, the lighting contactor panels shall be provided with selector switches and control relays. Selector switches and control relays shall be heavy duty industrial type.

4. Receptacle and Switches

a. General:

1) Receptacles and switches shall be provided in accordance with the Contract Documents. The receptacles and switches shall be complete and shall include all accessories for proper installation.

2) Outlet boxes for receptacles and switches shall be in accordance with Section 26 05 33 – Raceway and Boxes for Electrical Systems.

3) Unless specifically shown otherwise or stated in the Contract Documents explosion proof devices in hazardous locations shall comply with the requirements of the NYCEC for Class I, Division 1, Group D locations.

5. Receptacles:

a. Receptacles shall be duplex grounding type, two pole, three wire, 125 volt AC, 15 ampere. Where shown on the Contract Drawings, other special receptacles with number of poles, voltage and current rating shall be provided. Matching plugs shall be provided for each special receptacle.

b. Receptacles for indoor dry, dusty locations shall be heavy duty, straight blade type, with reinforced polyester base and impact resistant nylon face.

c. Receptacles for wet and corrosive locations shall be marine duty, straight blade type, with heat resistant melamine body. Special receptacles in wet and corrosive locations shall be Type 316 stainless steel.

d. Receptacles for hazardous locations shall be factory sealed and shall be in accordance with the following:

    1) Explosion-proof type receptacles shall be of the delayed action type requiring the turning of a plug shell on withdrawal to allow time for extinction of arcs.

    2) Surface mounted explosion-proof receptacles shall be provided with cast iron or cast aluminum angle type covers with hinged flaps.

    3) Flush mounted explosion-proof receptacles shall be provided with brass, chromium plated, flush plates with double hinged flaps.

    4) Plugs shall be provided where required for each type of explosion-proof receptacle. Plugs shall be of explosion-proof construction, and shall have steel bodies with corrosion resistant finish. Plugs shall be fitted with aluminum alloy cable clamps and chloroprene cable bushings.

e. Receptacles for installation in floors shall be in accordance with the following:

    1) Floor receptacles shall comprise a watertight unit consisting of a cast iron box with an adjustable top, permitting permanent angular and vertical adjustment, brass cover plate and 3/4 inch brass floor extension. The extension shall be of an approved height and shall be surmounted with a brass head arranged for a duplex receptacle. Exposed metal parts shall be finished to match adjacent metal finish.

    2) For low voltage signal and telephone work, floor outlets shall be equal to those specified above for floor installation, except that the interiors shall be designed for cable extension as approved.

f. Fan or clock outlets shall be single receptacles with molded composition or bakelite bodies. Rating shall be 15 amperes, 125 volts. Fan outlets shall be furnished with stud supports. Clock outlets shall be of the recessed type and shall be furnished with yokes for clock support.

g. 480 volt receptacles in non-hazardous areas shall be a mechanically interlocked type with circuit breaker disconnect. The disconnect cannot be closed until the plug is fully inserted and the plug cannot be withdrawn or inserted unless the switch is open. The receptacle enclosure shall be copper - free aluminum with stainless steel parts.

6. Switches:

a. Switches shall be industrial-heavy duty, AC toggle quiet type. Switches shall be rated 120/277 volt, 20 ampere. Poles and switching shall be as shown on the Contract Drawings.

b. Switches for hazardous locations shall be factory sealed tumbler type. The switch body and cover shall be cast gray iron alloy or cast malleable iron with zinc electroplate finish.

7. Plates and Covers:

a. Stainless steel plates shall be furnished for devices in indoor dry, dusty locations. They shall have beveled edges and shall be made of Type 316, stainless steel.

b. Plates shall have satin finish. Attachment screws shall have matching head finish.

c. For wet and corrosive locations neoprene gasketed covers shall be used. Covers shall be galvanized ferrous or cast ferrous metal. Covers shall be PVC-coated in corrosive locations. Covers shall be equipped with gasketed spring doors for receptacles and an external operating mechanism for switches.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Luminaires

1. Luminaires shall be installed at locations shown on the Contract Drawings. Luminaire locations shall be adjusted where necessary to clear conflicts and obstructions.
2. All luminaires shall be installed complete with all hardware, and supporting devices necessary to make a safe complete and fully operative installation.
3. The Contractor shall obtain from the manufacturer for each luminaire, diagrams, illustrations and other installation instructions. The Contractor shall install in strict conformance with such instructions and the requirements of NYCEC.
4. Recessed fixtures shall be installed in suspended ceiling openings in conformance with manufacturer's recommendations and to suit the architectural details of the area involved. Independent supports from structural members of the building shall be provided.
5. Pendent mounted fixtures shall be installed with pendants 1/2 inch for stems up to 5 feet and 3/4 inch for longer lengths.
6. All pendant stem hangers shall be furnished with suitable aligner canopies or outlet box covers so that the luminaires hang vertical to the finished floor irrespective of the angle of the surface from which they are suspended. When luminaires or hanger canopies are mounted flush to the ceiling or wall, and where raceways and outlet boxes serving the luminaires are surface mounted to the ceiling or wall, finishing rings shall be provided to conceal the outlet box. All visible hanging devices and appurtenances shall have the same finish as the luminaire.
7. Reflectors, lenses, diffusers, louvers and decorative elements of luminaires shall not be installed until completion of plastering, ceiling tile work, painting, and general clean-up in the area.

B. Emergency Inverter System:

1. Equipment shall be installed in accordance with manufacturer's instructions and recommendations.
2. Equipment shall be installed on concrete pads at locations indicated on the Contract Drawings so that sufficient access and working space is provided for ready and safe operation and maintenance.
3. Install system nameplates for identification of equipment.

C. Lighting Contactor Panels:

1. Panels shall be mounted rigidly and securely to the building structure or to supporting devices which are rigidly and securely supported to the building structure.
2. Panels shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units and with machine screws or welded studs on metal.

3. All panels shall be mounted parallel or perpendicular to walls, such that panels are installed in a neat and professional manner.

D. Receptacles and Switches:

1. Receptacles and switches shall be installed within outlet boxes at locations indicated on the Contract Drawings and in accordance with code requirements.

2. Receptacles shall be mounted 2 feet above the finished floor, except in hazardous locations where receptacles shall be mounted 4 feet-6 inches above the finished floor.

3. Switches shall be mounted 4 feet 6 inches above the finished floor.

4. Where devices are grouped they shall be mounted under a common plate. Where directed or where space conditions limit gang mounting, tandem or tandem gang arrangement shall be provided.

5. Where four or more switches controlling fixtures that are not visible from the switch location are grouped, the switch plate shall be engraved and filled with colored material or otherwise suitably marked to designate the control of each switch.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, the completed lighting system and receptacle devices shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:

a. Wiring continuity test shall be performed.

b. Branch circuit load balance test shall be performed.

c. Fixture and control operation test shall be performed.

d. Emergency inverter system operation and functionality test shall be performed.

e. Receptacle polarity and grounding.

B. Reports

1. The Contractor shall provide a field test report. The report shall identify the test performed and the results obtained.

C. Manufacturer’s Field Services

1. A qualified manufacturer’s service representative shall assist in the installation of the emergency inverter system, check the installation before it is placed into operation, assist in the performance of field tests, observe the initial operation and train the plant operations and maintenance staff in the care, operation and maintenance of the system.

2. The Contractor shall provide equipment start-up services and training in accordance with this Section and the Contract Documents.

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training instruction and all other pertinent information.

4. The service representative shall sign in with the Engineer on each day they are at the Site.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning of Luminaries

1. Luminaires shall be cleaned inside and out to remove construction dust prior to the start of Field Tests and again prior to substantial completion at the direction of the Engineer.

2. Fixtures shall be relamped prior to substantial completion.

END OF SECTION

SECTION 26 56 11 – OUTDOOR LIGHTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for providing outdoor lighting. Outdoor lighting shall be provided in accordance with the requirements under this Section and the Contract Documents.

B. The outdoor lighting system shall be complete and include all luminaires, poles, pole bases, reinforced concrete foundations and accessories as required for the installation of the outdoor lighting.

C. The Contractor shall perform all excavations, complete all forms, and do backfilling and tamping as required, unless specifically shown otherwise on the Contract Drawings.

D. The following index of this Section is included for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 03 21 00 - Reinforcing Steel

C. Section 26 51 11 – Lighting Fixtures, Devices and Schedules

D. Section 31 23 16 - Excavation

E. Section 31 23 23 - Fill

1.04 REFERENCES

A. Outdoor lighting shall comply with the latest applicable provisions and recommendations of the following even if not specifically listed in this Section:

1.	DLC PR	-	DesignLights Consortium Premium Technical Requirements
2.	EISA 2007	-	Energy Independence and Security Act of 2007
3.	IES LM-79	-	Approved Method: Electrical and Photometric Measurements of Sold State Lighting Products
4.	IES LM-80	-	Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
5.	IES TM-21	-	Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources
6.	NEMA SSL-1	-	Electronic Drivers for LED Devices, Arrays, or Systems.
7.	NYCEC	-	New York City Electrical Code.
8.	UL 1029	-	High Intensity Discharge Lamp Ballasts.
9.	UL 1572	-	High Intensity Discharge Lighting Fixtures.
10.	UL 1598	-	Luminaires
11.	UL 8750	-	Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. General

1. Luminaires shall be UL listed and approved for use in the City of New York and comply with NYCEC.
2. The types of luminaires are noted within the fixture schedule which is shown in this Section. The descriptions and catalog numbers serve to establish the quality, appearance and performance of the specified luminaires.
3. Luminaires shall comply with DLC PR.
4. All outdoor lighting luminaires, poles and associated equipment shall be the products of lighting equipment manufacturers and manufacturers who have previously demonstrated, by performance and reputation, the ability to manufacture products of the quality specified and shall have a minimum of 5 years' experience manufacturing the specified products. Such manufacturers must maintain an organization and manufacturing facility capable of actually manufacturing the specified luminaires, poles and associated equipment. For the purpose of inspection, Contractor shall assure the Engineer, free and easy access to the manufacturing facilities and inventories of any manufacturer whose equipment the Contractor proposes to supply.
5. Outdoor lighting system shall use low carbon alloy steel with minimum yield strength of 50,000 psi or stainless steel bolts, nuts, washers and screws.
6. Contractor shall ensure that all metals used for poles, bases, support hardware, bolts, nuts washers and screws are of similar material composition and where different, steps are taken to mitigate the effects of corrosion.

B. Field Testing

1. The outdoor lighting system shall be field tested. The field testing shall be performed in accordance with the requirements specified under this Section.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittal shall include, but not be limited to:

1. A list of proposed manufacturers with the products they produce proposed for the Contract.
2. Manufacturer's catalog cuts and drawings showing all technical information, and construction details for luminaires, including dimensions, type of wiring, weight, size, installation methods and provisions for relamping luminaires from the ground.
3. Photometric data developed for each fixture including IES BUG ratings, isolux diagrams and IES lighting classification.
4. Lamp type and technical information.

5. Ballast type and technical information including power factor, input watts and ballast factor.

6. Driver type for LED and technical information including input voltage, power factor, Crest Factor and THD.

7. Pole and base construction details. For poles submit wind loading, complete dimensions and finish, include anchor bolt sizing and circle diameter.

8. Scaled Shop drawings showing the locations of all luminaires and shall include the proposed routing of supply conduits.

9. Bills of material.

B. Reports:

1. Field test reports shall be submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Outdoor lighting equipment shall be delivered, stored and handled in accordance with this Section, the Contract Documents and the manufacturer's instructions.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Spare Parts

1. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the outdoor lighting in accordance with this Section and the Contract Documents.

2. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

3. The following spare parts shall be furnished, with all fractions rounded up to the next number:

a. 10 percent lamps, lamp module or array shall be provided of each wattage of each type of lamp, lamp module or array but not less than the requirement for two luminaires.

b. Where the lamp, lamp module or array is an integral part of the luminaire and the lamp, lamp module or array is not normally replaceable provide spare luminaires instead.

c. 5 percent ballasts or drivers shall be provided of each type of type ballast or driver, but not less than two.

d. 10 percent fuses shall be provided of each size and type, but not less than two.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Luminaires

1. Manufactures of luminaires shall be in accordance with Section 26 51 11 – Lighting Fixtures, Devices and Schedules.

B. Breakaway In-Line Streetlight connectors shall be as manufactured by:

1. Buchanan, Hackettstown, NJ;
2. Ideal Industries, Sycamore, IL;
3. Ilsco, Cincinnati, OH;
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Luminaires

1. Luminaires shall be provided for each lighting fixture symbol shown on the Contract Drawings and in accordance with the lighting fixture schedule shown in this Section.
2. Heights of all outdoor luminaires shall be as shown on the Contract Drawings.

B. Poles and Bases

1. Poles and bases shall be provided in accordance with the details shown on the Contract Drawings.
2. Poles shall have a wind load rating of at least 90 mph with a gust factor of 1.3.
3. Where shown on the Contract Drawings, bases shall be provided with plug receptacles, fuses, cut-outs, switches or other devices for protection and ease of maintenance. Devices shall be in accordance with the following:
    a. Receptacles shall be housed in cast iron hot-dipped galvanized boxes and shall be watertight, heavy duty type with screwed caps.
    b. Switches shall be enclosed in hot-dipped galvanized cast iron boxes. Where shown on the Contract Drawings switches shall be provided with fuses.

c. Where shown on the Contract Drawings, fused applications shall be provided with breakaway watertight, in-line fuse kits.

C. Reinforced Concrete

1. Concrete for pole foundations shall be in accordance with Section 03 30 00 - Cast-in-Place Concrete, and the concrete steel reinforcement shall be in accordance with Section 03 21 00 – Reinforcing Steel.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Luminaires shall be installed at locations indicated on the Contract Drawings. Fixture locations shall be adjusted where necessary to clear conflicts and obstructions.

B. Excavation for luminaire poles shall be in accordance with the requirements of Section 31 23 16 - Excavation.

C. Backfilling for fixture poles shall be in accordance with the requirements of Section 31 23 23 - Fill.

D. Luminaire poles shall be installed on reinforced concrete foundations as shown on the Contract Drawings. Poles shall be installed in accordance with standard procedures and as recommended by the manufacturer.

E. Poles shall be wired with strain relief provided. A green grounding conductor shall be installed with each circuit, grounding by conduit method shall not be permitted.

F. Provide a lighting contactor panel with ON-OFF-AUTO-MANUAL switches for exterior lighting control and manual override as indicated on the Contract Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Tests

1. After installation, the completed outdoor lighting system shall be field tested for operation and conformance.

2. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:

a. Wiring continuity test shall be performed.

b. Branch circuit load balance test shall be performed.

c. Fixture and photo cell operation test shall be performed.

B. Report

1. The Contractor shall provide a field test report.

2. The report shall identify the tests performed and the results obtained.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning of Outdoor Lighting

1. Luminaires shall be cleaned inside and out to remove construction dust prior to Substantial Completion.

2. Luminaires shall be relamped prior to Substantial Completion.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall design, furnish, install, test and place into satisfactory operation Video Surveillance System as specified herein and in compliance with the Contract Drawings and all applicable codes and standards.

B. Equipment and materials used shall be standard components that are manufactured and available for purchase as standard replacement parts as long as the product is commercially available from the manufacturer. All manufactured products shall be thoroughly tested and proven in actual use.

C. All manufactured products shall include, at no additional cost, online support services and availability of a toll-free (U.S. and Canada), 24-hour technical assistance program (TAP) for emergencies.

D. The manufacturer shall repair or replace without charge manufactured products proven defective in material or workmanship for the stated warranty period from the date of shipment.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage and Handling	7
1.09	Spare Parts	7
1.10	Warranty	7
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	26
2.04	Source Quality Control / Shop Tests	34
PART 3	EXECUTION	35
3.01	Examination / Preparation	35
3.02	Installation	35
3.03	Field Testing / Quality Control	36
3.04	Startup / Demonstration	38
3.05	Adjusting / Protection / Cleanup	39

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittals Procedures

B. Section 01 43 10 – Quality Assurance Inspection

C. Section 01 65 00 – Product Delivery Requirements

D. Section 01 78 24 – Spare Parts and Maintenance Materials

E. Section 01 78 25 – Operations and Maintenance Manuals

F. Section 26 05 11 – General Electrical Requirements

G. Section 26 05 20 – Low Voltage Wires, Cables and Accessories

H. Section 26 05 27 – Grounding

I. Section 26 05 29 – Hangers and Supports for Electrical Systems

J. Section 26 05 33 – Raceways and Boxes for Electrical Systems

K. Section 26 05 53 – Identification for Electrical Systems

L. Section 40 61 13 – PMCS General Requirements

M. Section 40 80 81 – PMCS Factory Testing

N. Section 40 80 82 – PMCS Startup and Field Testing

1.04 REFERENCES

A. Certifications:

1. CE, Class A; meets EN50130-4 standard requirements
2. FCC, Class A
3. UL/cUL Listed
4. C-Tick
5. CCC
6. KCC

B. Standards/Organizations

1. MPEG-4 Industry Forum
2. Universal Plug and Play (UPnP) Forum, Steering Committee
3. Universal Serial Bus (USB) Implementers Forum

4. Internal Standards for Organization/Electrotechnical Commission (ISO/IEC) Joint Technical Committee 1 (JTC1). "Information Technology"
5. ISO/IEC 14496 standard (also known as MPEG-4)
6. International Telecommunication Union (ITU), Recommendations G.711, "Pulse Code Modulation (PCM) of Voice Frequencies"
7. ONVIF Open Industry Forum.

C. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits.
2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

D. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

E. State and Local Building Codes.

1. NYC Building Code
2. NYC Electrical Code

1.05 DESCRIPTION

A. The IP video system shall include video cameras, mounting brackets, network video recorders, power over ethernet switches, dual RTU interfaces, power supplies, video monitor, custom keyboard and mouse, equipment enclosure or console, conduit, cables, wiring, fittings, and all required system accessories required to provide a complete operating system. All cables and connectors for video, audio, PoE network, illuminators, wipers, and accessories shall also be provided in the vendor-supplied equipment.

B. The IP video management system shall consist of Digital Sentry® NVs version 7 software operating on an optimized Pelco-supplied hardware platform. The NVs software shall consist of base software with individual, non-expiring licenses in the required quantity.

C. The IP video management system software updates shall be downloadable from a publicly available website.

D. The IP video management system shall:

1. Support up to 128 combined IP and analog video streams, with up to 64 direct-attached analog cameras. Analog streams shall be supported using Pelco and/or third-party encoders.
2. Provide 350 Mbps for RAID5, 300 Mbps for JBOD systems throughput for recording of analog and IP video streams, playback and export.
3. Include SSD system drive to increase responsiveness.

4. Support recording of JPEG, MPEG-4 and H.264 IP streams.

5. Support Pelco and third-party H.264 Megapixel video streams up to 10 Megapixel resolution with quantities based on a total system of 300 Mbps throughput for recording of analog and IP video streams, playback and export.

6. Designed for a fully open architecture with support for both IP-specific camera as well as cameras with ONVIF compliance.

7. Enable automatic detection of Pelco IP cameras and, if any, third-party IP cameras.

1.06 QUALITY ASSURANCE

A. Comply with the requirements specified in Section 01 43 10 - Quality Assurance Inspection.

B. Standard Products: Material and equipment shall be the latest standard products of a single manufacturer regularly engaged in the manufacture of the product for the 5 years as a minimum.

C. Qualifications of the installer before commencing work: Submit information demonstrating that the supplier has successfully installed Video Surveillance Systems of the same scope, type and design as specified.

1. Submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

2. Employ on staff a minimum of one full-time NICET certified Video Security Systems Technician.

3. Certify that the completed system conforms with applicable codes and standards upon completion of the installation.

4. Submit a proposal for regular maintenance and testing under a maintenance contract with the City.

D. Nameplates: The components of equipment shall have the manufacturer's name, address, type or style, contract tag number and catalog number on a plate securely attached to the equipment.

E. Tags: Tags with stamped identification number shall be furnished for keys and locks. Tags shall be furnished to identify cable and conduit runs, wiring circuits, and all spare parts furnished for Authority's stock to maintain the system.

F. Keys and Locks: All locks shall be keyed alike.

G. Verification of Dimensions: Become familiar with details of the work and verify dimensions in the field.

H. Accessibility: Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in

a single cabinet large enough to accommodate all units and allow ample gutter space for interconnections of panels and field wires.

I. Verify conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier.

J. Review selected arrangement with local fire authority for conformance with local and state requirements.

K. Onsite Technician Services:

1. Provide the services of a representative or technician certified by the manufacturer of the system, experienced in the installation and operation of the type of system provided.

2. The representative shall be licensed in the State if required by law.

3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system, and Underwriters Laboratories listing certification requirements.

4. The technician shall provide the required instruction to the City's personnel in the system operation, maintenance and programming.

5. Provide services of the manufacturer's service representative during installation, startup and testing, for a period of three working days plus travel where a working day is equivalent to 8 hours.

1.07 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1. Copy of this Section with addenda and all referenced Contract Sections with addenda check-mark each paragraph to indicate specification compliance or indicate deviation and reason for deviation.

a. Failure to include a copy of the marked-up Contract Sections will result in return of the entire submittal with no further review and consideration.

2. Installer and system supplier qualifications and list of three similar projects with name and phone number of contact person.

3. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop drawings shall contain complete conduit riser diagrams, wiring diagrams, plan layout drawings, schematic diagrams and sequence of operations for all equipment, devices, conduits and cables furnished. Riser diagrams shall identify cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

4. Manufacturer's printed installation instructions.

5. Battery capacity calculations to demonstrate that the battery size selected is a minimum of 125 percent of the calculated requirement. Calculation to include supervisory power requirements for all equipment and accessory power requirements for all equipment.

6. Wiring diagrams from the system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.

7. Voltage drop calculations based on field measured wiring distances indicating that signaling and notification appliance circuits do not exceed the manufacturer's recommended maximum voltage drop for each type of circuit.

B. Spare Parts Data:

1. After approval of the list of Shop Drawings, and not later than six months prior to the date of Substantial Completion, furnish copies of spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies with current unit prices and source of supply, a list of supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified to be furnished in accordance with paragraph Special Tools and Spare Parts and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days.

C. Operating and Maintenance Instruction Manuals:

1. Upon approval of submittals required in 1.04.A and prior to the end of project, submit operating instruction manuals as specified in Section 01 78 25 - Operations and Maintenance Manuals, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and detailed description of all equipment and their basic operating features. The operating instruction manuals shall include all approved riser, plan, wiring and schematic drawings as well as detailed sequence of operations tables.

2. Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.

3. Performance Test Reports: Upon completion of the installed system, submit in field tests performed to prove compliance with the specified performance criteria and as detailed in Part 3 of this specification.

D. Submit Certificate of Compliance, signed by manufacturers of Video Surveillance System components certifying that their products comply with specified requirements.

E. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings and approved Shop Drawings as needed to depict component locations and wiring to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Upon receipt of approval, resubmit all impacted submittals required to make clarifications or revisions to obtain approval.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 01 65 00 - Product Delivery Requirements.

B. Equipment placed into storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.09 SPARE PARTS, SPECIAL TOOLS AND SUPPLIES

A. Comply with the requirements specified in Section 01 78 24 – Spare Parts and Maintenance Materials.

B. The manufacturer shall also submit a list of recommended spare parts to be furnished for review by the Engineer.

1.10 WARRANTY

A. The Contractor shall provide a warranty from the equipment manufacturer, warrantying all equipment furnished under this Section against defects in workmanship and material for a period of twenty-four (24) months from the date of Substantial Completion. The warranty shall include the following:

1. All costs for labor, transportation, freight and replacement parts required to satisfactorily repair any piece of equipment as a result of equipment malfunction during the warranty period.

2. A report shall be submitted after each site visit describing the problem, solution, all work performed, and parts replaced.

3. All work shall be performed by the equipment manufacturer or authorized representative.

B. The cost of this warranty shall be included in the lump sum price bid for the Contract.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pelco, a Motorola Solutions company, Fresno, CA.

B. No substitution allowed.

2.02 MATERIALS / EQUIPMENT

A. IP Video Management System

1. Video Surveillance System shall comply with Section 40 61 13 – PMCS General Requirements.

2. The IP video management system shall support an unlimited number of systems connected over a network. Each system shall contain two 1GB network ports; one for IP camera/encoder data, and one to connect to a network for client computer access.

3. The IP video management system shall be viewed, managed, and played back through a single user interface simultaneously with other Digital Sentry digital video management systems through supplied DS Admin or DS Control Point Client software.

4. The IP video management system shall operate on a 4th Generation Intel® Xeon processor and 8 GB of RAM.

5. The IP video management system shall contain two DVI-D ports.

6. The IP video management system shall utilize latest Microsoft Windows® 64-bit operating system.

7. The IP video management system shall support and have an internal DVD+/-RW.

8. The IP video management system shall allow expansion of IP video channel capacity through licensing without any hardware modification.

9. The IP video management system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis.

10. The IP video management system shall allow archival of video data to computers or SAN storage devices over a network connection with the optional DS Archive Utility. The archival schedule shall be either automatic at user-defined intervals or manual and shall be configurable per connected camera.

11. The IP video management system shall support network health and monitoring utilizing third-party SNMP monitoring tools.

12. The IP video management system shall indicate system performance and operation status utilizing a variety of HTML reports.

13. The IP video management system shall optionally support on-board video analytics in quantities of two or four channels with Active Alert software and the DS DataPoint interface. The DS DataPoint interface shall provide video analytics monitoring including tracking and counting objects and people.

14. The IP video management system shall support Lightweight Directory Access Protocol (LDAP).

B. System Specifications

1.	Processor		Latest Intel® Xeon
2.	Operating System		Latest Windows 64-bit
3.	Internal Memory		8 GB DDR3 non-ECC RAM; 16GB DDR ECC RAM for DSSRV2-RD models
4.	Network Interface		Gigabit Ethernet (1000Base-T) ports (2x)
5.	User Interface		DS Control Point
6.	Internal Storage (JBOD or RAID 5)		
	a.	DSSRV2	8 TB
	b.	DSSRV2-DVD	8 TB
	c.	DSSRV2-RD	12 TB
7.	Raid Level		Internal RAID 5 (requirs DSSRV2-RAID controller card for hot swappable drives)
8.	External Storage		Pelco's DX8100HDDI
9.	System Drive		SSD
	a.	DSSRV2	6, 3.5-inch hard drive bays
	b.	DSSRV2-DVD	4, 3.5-inch hard drive bays
	c.	Optical Drive	DVD±RW with DSSRV2-DVD
	d.	USB Ports	3 USB 2.0 (1 front, 2 rear), 2 USB 3.0 (rear)
10.	Power Input		100 to 240 VAC, 50/60 Hz, autoranging
11.	Power Supply		Internal, 115 VAC, 60 Hz
12.	Power Consumption		215.5 Watts, 1.87 Amp, 735.7 BTU/H
13.	Front Panel Indicators/Functions		
	a.	Buttons	Power
	b.	Indicators:	
		1)	Unit Status – Green, amber, red
		2)	Primary Network – Green, amber, red

3) Secondary Network – Green, amber, red

4) Software Status – Green, amber, red

5) Hard Disk Status – Green, red, off (behind bezel)

C. Video Specifications

1. Video System		Latest Intel HD Graphics
a.	Maximum Resolution	3840 x 2160 per DisplayPort output (2x) 1920 x 1200 @ 60 hz on DVI-D output 1920 x 1200 @ 60 hz on VGA output
2. Video Outputs		Up to 3 simultaneous displays using any combination of the four outputs
3. Video Standards		60 Hz capable for NTSC; 75 Hz capable for PAL
4. Video Decoding Supported		MPEG-4 ASP; H.264 Baseline, Main, and High profiles
5. Decoding Performance		16X real-time MPEG-4 streams at 704 x 480; 12X real-time H.264 Baseline profile streams at 704 x 480; 4X H.264 Baseline profile streams at 720p; 2X real-time H.264 Baseline profile streams at 1080p

D. Audio Specifications

1. Audio Decoding		G.711 speech codec
2. Audio bit-rate		64 kbps
3. Audio Levels		
a.	Input	Electret microphone
b.	Output	Up to 3 Vp-p, adjustable, minimum load of 8 ohms
4. Audio Connectors		2, 3.5 mm stereo jacks
a.	Connector Tip	Signal left (input and output)
b.	Connector Ring	Signal right (input and output)
c.	Connector Sleeve	Common
5. Audio Inputs		Microphone
6. Audio Outputs		Speaker or in line

E. Environmental Specifications

1. Operating Temperature	10º to 35ºC (50º to 95ºF)

2.	Operating Humidity	20% to 80%, noncondensing
3.	Max. Humidity Gradient	10% per hour
4.	Operating Altitude	–15 to 3,048 m (–50 to 10,000 ft)
5.	Operating Vibration	0.25 G at 3 Hz to 200 Hz at a rate of 0.5 octave/minute

F. Supplied Accessories

1.	Power Cord	1 USA standard; all cables are 3 prong, molded connector, 1.8 m (6 ft)
2.	USB Keyboard and Mouse	1
3.	Bezel Key	2
4.	Rack Mount Kit	Brackets, rails, and hardware for mounting in a 2 RU rack
5.	DSSRV-LIT	Documentation
6.	USB-DS	Imaged with DS NVs and includes resource documentation

G. IP Video Management Client Software requirements

1. The IP video management system shall provide the capability of running a client application in addition to the video management system.
2. A client computer with system compatible software shall be the user interface for viewing one or more systems. Live and recorded video and current event video shall be displayed on any client computer using a proper login and password. The client computer shall be able to connect to an unlimited number of recorders simultaneously to display live and recorded video.
3. Client Software shall be unlicensed and available to be installed on as many clients as required by the user.
4. Client Software shall be compatible with multiple DVR and NVR platforms to include all Pelco Digital Sentry®, Pelco DX8000/8100, DX4500/4600/4700/4800 and DX4700/4800HD.
5. Client Software shall be password controlled such that password functionality set at each connected system will be recognized at the client. Password shall limit the ability to access live or recorded video as well as the ability to export video.
6. Client Software shall allow multiple monitor support for up to four displays per client workstation, providing virtual matrix functionality.

7. Client Software shall allow the connection of Pelco KBD5000 keyboard controllers to the client workstation to control PTZ operations and camera call-up.
8. Client Software shall allow video streams to be selectable from a system tree on an individual camera, individual system, client defined local groups, or from predefined recorder-based groups.
9. Client Software shall be a tab-based work environment with the ability to undock the tabs creating a virtual workspace on single or multiple monitor clients.
10. Client tabs shall include system management, live, and search options. Tabs can be displayed simultaneously on the client.
11. Systems Tab shall display and sort available systems, connection status, system names, system IP addresses, and custom categories. This tab shall additionally allow:
    a. Manual connect and disconnect of systems to the client
    b. Virtual systems naming
    c. Auto Connecting
    d. Adding, deleting, and editing available systems
    e. Live video tab shall have the ability to be created up to four times on a single client workstation providing for video display combinations and simultaneous video streams from as many different systems with consideration for maximum client bandwidth.
12. Live video tab shall provide the following functionalities:
    a. Quick Review which shall display recorded video from the last 1, 5, 15, 30, 60 or 90 minutes, providing near instantaneous review of recent events
    b. 15-day graphical display of recorded video
    c. Borderless display option
    d. Screen layout selection
    e. On the fly on-screen display changes including time, date, camera name, frame rate, frame size, alarm display, and border indicators
    f. Digital zoom
    g. User selectable in-video PTZ control or dashboard style control
    h. Drag and drop audio support associating any audio with any video

i. Search video tab shall allow for the search of one or multiple cameras from one or multiple systems simultaneously. Search tab shall provide the following functionalities:

j. Time and date search

k. Advanced data search with DataPoint interfaced software to Active Alert Intelligent Video and POS

l. Drag and drop audio support to associate audio with any video

13. Video export to any system accessible media including locally to HDD, CD/DVD, Flash USB device or to network storage.

14. Video authentication of exported video via check sum verification.

15. Alarm video tab shall allow for alarm pop-up and playback of active alarms. Alarms may be based on motion activity, an external software trigger from Active Alert analytics or a preset data alarm from DS DataPoint. An alarm list pane shall be displayed for playback of queued alarms.

16. The Client shall incorporate virtual matrix functionality whereby camera sequences may be created on the monitoring workstation with the following functionalities:

17. Each sequence shall have a maximum of 500 cameras.

18. Each camera in the sequence shall have its own individual dwell time, from 1 to 60 seconds.

19. Each entry in a sequence shall have the capacity to trigger PTZ camera presets, patterns, or auxiliaries.

20. The Client shall have the capability to display recorded video with full VCR controls. This feature shall display video from multiple cameras simultaneously. The user shall be able to play video as fast as possible (all images), in real time, or by skipping a selectable number of seconds.

21. The Client shall support simultaneous playback of up to sixteen cameras all synchronized with each other. Non-synchronous playback of multiple cameras shall not be acceptable.

22. The Client shall support tours of multi-camera displays.

H. Explosionproof Cameras

1. The explosionproof pan and tilt camera system shall offer a 1920 x 1080 maximum resolution Integrated Camera/Optics Packages, 30X optical zoom, 12X digital zoom with an infrared cut filter, day/night, and built-in motion detection.

2. The explosionproof pan and tilt camera system shall be designed for hazardous, harsh, and marine environments, and shall be certified as such.

3. The explosionproof pan and tilt camera system shall provide up to a 1000Base-T network interface for live streaming to a standard Web browser or a VMS.
4. The explosionproof camera shall support FSFP/SFP modules that are Multi-Source Agreement (MSA) Compliant, adapting to multiple transmission methods; fiber, Ethernet over coax, UTP.
5. The explosionproof pan and tilt camera system shall provide auto focus and auto iris with manual override.
6. The explosionproof camera system shall be designed to mount upright.
7. The explosionproof pan and tilt camera system shall use a standard Web browser interface for remote administration and configuration of camera parameters.
8. The explosionproof pan and tilt camera system shall be conformant to ONVIF S, G, and Q and support open architecture connectivity for third-party software recording solutions allowing integration into virtually any IP-based system. It is also compatible with Endura 2.0, Digital Sentry® 7.3, and VideoXpert 1.9 (or later) video management systems. As with all Pelco IP camera solutions, Exsite Enhanced is Endura Enabled™ to record, manage, configure, and view multiple live streams.
9. The explosionproof pan and tilt camera system shall include a programmable window wiper and washer/wipe sequence under a single command.
10. The explosionproof camera shall operate between -60C and 60C
11. The explosionproof camera shall maintain a T6 (<85C) surface temperature in all operating conditions.
12. The explosionproof camera shall cold-start from >-30º C
13. The explosionproof camera shall support dual cable entry ports allowing the installer to separate power and data cables or to install cables flexibly.
14. The explosionproof camera shall include a safety attach point.
15. The explosionproof camera shall include an integrated wiper to keep the viewing window clean.
16. The explosionproof camera shall include a sun shroud and support a heater and window defroster, ensuring that the camera functions and captures video in extreme weather.
17. The explosionproof camera shall have a heating system to keep the window ice free to -35C.
18. The explosionproof camera shall include an internal microSD slot, allowing the camera to record locally.

19. The explosionproof camera shall be programmable to perform actions based upon up to 4 physical alarm triggers.
20. The explosionproof camera shall have a local (on-camera), hardware (two wires for button in safe room), and software (at VMS) reset options.
21. The explosionproof camera shall support 32 window blanks to conceal user-defined privacy areas that cannot be viewed by an operator.
22. The explosionproof camera shall be conformant to the ONVIF Profile S, G, and Q support open architecture best practices with a published API available to third-party network video recording and management systems.
23. The explosionproof camera shall provide the ability backup and restore camera settings through an embedded Web browser.
24. The explosionproof camera shall provide Wide Dynamic Range (WDR) up to 130dB with selections for on/off available through the embedded Web browser.
25. The explosionproof camera shall provide dynamic White Balance adjustments through the embedded Web browser
26. The explosionproof camera shall provide dynamic focus settings to provide on/off options for Auto Focus and Focus Trace based on the distance to the ground level targets in a scene.
27. The explosionproof camera shall provide 802.1x port security to establish point-to-point access through a wired or wireless port using Extensible Authentication Protocol (EAP). Supported EAP methods shall include EAP-MD5, EAP-TLS, EAP-TTLS, EAP-PEAP and EAP-FAST.
28. The explosionproof camera shall support SNMP v2c and v3.
29. The explosionproof camera shall support IPv6 configurations in conjunction with IPv4.
30. The explosionproof camera shall provide user-selectable configurations for day/night auto mode.
31. The explosionproof camera shall provide I-Frame interval configuration to increase or decrease the number of I-Frames per second.
32. The explosionproof camera shall provide smart compression capability for enhanced storage optimization. The explosionproof camera shall provide Electronic Image Stabilization (EIS).
33. The explosionproof camera shall include an optional DEFOG feature to make a subject appear clearer when the surrounding area of the subject is foggy and low contrast.
34. The explosionproof camera shall provide two simultaneous video streams with up to 8.00 Mbps. The second stream is variable based on the setup of the primary stream.

35. The explosionproof camera shall provide Quality of Service (QoS) for different Services Code Point (DSCP): A mechanism for prioritizing network traffic.

36. The explosionproof camera shall provide the ability to run embedded Pelco Video analytics.

    a. Pelco Analytic Suites shall be configured and enabled using a standard Web browser.

    b. Pelco Analytics for ExSite Enhanced Series including:

        1) Abandoned Object: Detects objects placed in a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows.

        2) Adaptive Motion: Detects and tracks objects that enter a scene and then triggers an alarm when the objects enter a user-defined zone. This behavior is primarily used in outdoor environments with light traffic to reduce the number of false alarms caused by environmental changes.

        3) Auto Tracker: Detects and tracks movement in the camera's field of view. When the Auto Tracker behavior is configured, the system automatically pans and tilts to follow the moving object until the object stops or disappears from the monitored area.

        4) Camera Sabotage: Detects contrast changes in the field of view. An alarm is triggered if the lens is obstructed with spray paint, a cloth, or a lens cap. Any unauthorized repositioning of the camera also triggers an alarm.

        5) Directional Motion: Generates an alarm in a high traffic area when a person or object moves in a specified direction. Typical installations for this behavior include an airport gate or tunnel where cameras can detect objects moving in the opposite direction of the normal flow of traffic or an individual entering through an exit door.

        6) Loitering Detection: Identifies when people or vehicles remain in a defined zone longer than the user-defined time allows.

        7) Object Counting: Counts the number of objects that enter a defined zone or cross a tripwire. This behavior might be used to count the number of people at an entrance/exit where the traffic is light. This behavior is based on tracking and does not count people in a crowded setting.

8) Object Removal: Triggers an alarm if an object is removed from a defined zone.

9) Stopped Vehicle: Detects vehicles stopped near a sensitive area longer than the user-defined time allows. This behavior is ideal for suspicious parking, traffic lane breakdowns, and vehicles waiting at gates.

37. Camera Specifications

a.	Sensor Type	1/2.8-inch Type Exmor CMOS sensor
b.	Optical Zoom	30X
c.	Digital Zoom	12X
d.	Maximum Resolution	1920 x 1080
e.	Frame Rate	60 frames per second (fps) maximum
f.	Lens	f/1.6 ~ f/4.7, 4.3 mm, wide ~ 129.0 mm tele
g.	Horizontal View Angle	30X: 63.7° (wide) ~ 2.3° (tele)
h.	Aspect Ratio	16:9
i.	Light Sensitivity	Sensitivity in lux for 90% reflectance, f/1.6 (wide angle), 43 dB gain at 30 IRE (30% of signal level) with Sensitivity Boost OFF; 4X improvement to sensitivity with Sensitivity Boost ON
j.	Color, 33 ms	0.20 lux
k.	Color Low Light, 33 ms	0.03 lux
l.	Color, 250 ms	0.025 lux
m.	Color Low Light, 250 ms	0.008 lux
n.	Mono (33 ms)	0.06 lux
o.	Mono Low Light, 33 ms	0.004 lux
p.	Mono (250 ms)	0.008 lux
q.	Mono Low Light, 250 ms	0.001 lux
r.	Day/Night Capabilities	Yes
s.	IR Cut Filter	Yes
t.	Wide Dynamic Range	130 dB
u.	Iris Control	Auto iris with manual override

v. Backlight Compensation Yes

w. Automatic Gain Control Yes

x. Active Noise Filtering Yes

y. Electronic Image Stabilization Yes

z. Video:

1) The explosionproof camera shall support independently configurable primary and secondary streams plus service stream.

2) Compression type: H.264 High, Main, or Baseline profiles; and MJPEG with Smart Compression options

3) Service Stream: JPEG stream; the JPEGs will be the same resolution as the primary stream

4) Available resolutions (16:9 Aspect Ratio):

	MPx	Width x Height
a)	1080p	1920 x 1080
b)	720p	1280 x 720
c)	0.36	800 x 448
d)	0.23	640 x 360

5) Constant bit rate (CBR) and constrained variable bit rate (CVBR).

6) Frame rate: Up to 60, 50, 30, 25, 20, 15, 12, 10, 8, 7, 6, 5, 4, 3, 2, 1 (depending on the coding, resolution, and stream configuration)

7) Video streams shall support ONVIF profile S.

aa. Storage and Recording

1) The explosionproof camera control shall have onboard SD card storage.

2) Card type: micro-SD

3) Capacity: up to 32 GB

4) The local SD storage shall have the ability to be backed up to alternate media without removal of the SD card from the camera.

5) Local recording on the SD card shall commence upon loss of network connectivity, based on a pre-programmed schedule.

6) The camera shall record video continuously in the case of network outage.

7) Alarm recording: The explosionproof camera shall capture selectable 1, 5, or 10 second video clips on camera sabotage, motion detection, or alarm input.

8) Video recording and storage shall support ONVIF profile G.

bb. Analytics

1) Analytics shall be configured and enabled using a standard Web browser.

2) The explosionproof camera shall have the ability to detect motion within user defined areas of the video image.

3) Number of simultaneous running analytic behaviors: 2

4) Configurable behaviors:

a) Abandoned Object - Detection of objects placed in a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows.

b) Adaptive Motion - Detection and tracking of objects that enter a scene and triggering of an alarm when the objects enter a user-defined zone.

c) Auto Tracker: Detects and tracks movement in the camera's field of view.

d) Camera Sabotage - Detection of contrast changes in the field of view, suitable to detect lens obstruction or unauthorized repositioning of the camera.

e) Directional Motion - Detection of person or object moving in a specified direction.

f) Loitering Detection – Identification of people or vehicles remaining in a defined zone longer than a user-defined time.

g) Object Counting - Counting the number of objects that enter a defined zone or cross a tripwire.

h) Object Removal – Detection of object is removed from a defined zone.

i) Stopped Vehicle – Detection of vehicles stopped near a sensitive area longer than a user-defined time.

38. Additional Features

a. Alarm – The explosionproof camera shall have four alarm/sensor inputs and one relay output for alarm or control and one relay output for external washer.

1) The alarm input shall be able to detect an open or closed alarm state function in supervised modes.

2) Relay Output: ±30 VDC maximum, ±3.5 mA maximum

39. Network

a. Connectivity: Up to 1000 BASE-TX Ethernet with RJ-45 connector

b. Protocols supported

1) Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP)

2) Configuration: Dynamic Host Configuration Protocol (DHCP)

3) Web services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS)

4) Network services: Domain Name System (DNS), Network Time Protocol (NTP), Internet Control Message Protocol (ICMP), Simple Network Management Protocol (SNMP) v2c/v3, Universal Plug and Play (UPnP)

5) Media: Real-Time Transport Protocol (RTP), Real-Time Streaming Protocol (RTSP)

6) Multicast: Internet Group Management Protocol (IGMP)

7) Notifications: File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP)

8) Remote Access: Secure Shell (SSH)

9) Security: Secure Sockets Layer (SSL), IEEE 802.1x (EAP-MD5, EAP-TLS, EAP-TTLS, EAP-PEAP and EAP-FAST)

10) Quality of Service: IEEE 802.1p Layer 3 Differentiated Services Code Point (DSCP)

11) DDNS – The explosionproof camera shall support DDNS services offered by the Manufacturer and other publicly available service offerings.

c. Security

1) The explosionproof camera shall support IP address filtering whereby users can enter a list of allowed or blocked IP

addresses for viewing video and configuring camera settings.

2) The network camera system shall provide three levels of user access with password protection.

40. Camera Software

a. The explosionproof camera shall have a built-in web server which supports browser-based configuration.

b. The camera's web server shall allow access to camera information and all primary software functions.

c. The Manufacturer shall offer video viewer and configuration to implement the following actions:

1) Camera discovery

2) Live Video

a) Video stream selection

b) Video stream configuration

(1) Use preset video setting configurations

(2) Configure custom video setting

i. Compression type

ii. Resolution

iii. Image rate

iv. I-frame interval

v. H.264 profile

vi. Quality of Service (QoS)

vii. Bit rate control

(3) Multicast

(4) Unicast

(5) JPEG frame rate

c) Maximize view area of video to full size of browser

(1) Revert to normal view

d) Open stream in new window

e) Capture and save image as .jpg file

f) Resize viewing area

3) Image Settings

a) Image quality
b) Exposure
c) Focus
d) White balance
e) Window blanking
f) Digital zoom
g) Lighting mode
h) Video noise reduction
i) Digital processing (color and detail adjustment)
(1) Image enhancement
(2) Quick setup preset modes
(3) Sharpness
(4) Saturation
(5) Contrast
(6) Brightness
j) Exposure modes

4) Recording
a) Initiate instant record and playback
b) Manage SD card storage

5) Events
a) Configure event sources:
(1) External alarm events
(2) Analytic events
b) E-mail setup
c) Define web addresses for notifications

6) Camera network settings

7) System
a) Firmware upgrade
b) Reset to factory default (local, hardware remote, and software remote)
c) Set date, time, and NTP server synchronization
d) User access control

e) View and export camera settings

f) View system logs

d. Minimum System Requirements

1) Processor: Intel® Core™ i3 Processor, 2.4 GHz

2) Acceptable Operating Systems:

a) Microsoft® Windows® 7 (32-bit and 64-bit), or DirectX® 11

b) Windows XP Service Pack 3 with DirectX 9.0c

c) Mac OS X 10.4 (or later)

3) Memory: 4 GB RAM

4) Network Interface Card: 100 megabits (or greater)

5) Monitor: Minimum 1024 x 768 resolution, 16- or 32-bit pixel color

6) Acceptable Web Browsers:

a) Microsoft® Internet Explorer® 8.0 (or later, recommended for configuring analytics)

b) Mozilla® Firefox® 3.5 (or later)

c) Google Chrome™ (51 or later)

7) Acceptable Media Players:

a) Pelco Media Player

b) QuickTime 7.6.5 for Windows 7, XP, or Vista

c) QuickTime 7.6.4 for Mac OS X 10.4 (or later)

e. The Manufacturer shall offer an open API.

1) The Manufacturer shall support integrations as follows:

2) Video Management: VideoXpert™; Endura® 2.0 (or later); Digital Sentry® 7.3 (or later); Third-party system through Pelco API/SDK, ONVIF Profile S, ONVIF Profile G, and Profile Q

f. Mobile Application Pelco Mobile

g. Required Systems for Analytics

1) Pelco Interface: WS5200 Advanced System Management Software or VideoXpert system

2) Open API: The Pelco API can transmit behavior alarm data to third party applications information available at pdn.pelco.com

41. Electrical

a.	Voltage Input		48 VDC, 2A, or 100-240 VAC, 2A 60 Hz
b.	Voltage Input Range		±10%
c.	Power Consumption		Maximum 74 VA/74 W EXF1230-4N
			Maximum 85 VA/77 W EXF1230-7N
d.	Heater and Defroster		Hardware controlled
e.	Alarm		
	1)	Unsupervised	Detects open or closed alarm state
	2)	Supervised	Detects open and short alarm state with external 1-kohm resistor to detect alarm tampering
f.	Input		3.5 VDC maximum, 3.5 mA maximum
g.	Relay Output		30 VDC, 500 mA maximum

42. Mechanical And Environmental

a.	General Construction	316L stainless steel
b.	Finish	Electropolish
c.	Viewing Window	High transmissivity glass
d.	Operating Temperature	–76º to 140ºF (–60º to 60ºC)
e.	Cable Entry	Dual, 0.75-inch (1.91 cm) NPT threaded opening
f.	Effective Projected Area:	191 square inches (1,232 square cm)

g. Integral Windshield Wiper: Programmable with a washer/wipe sequence under a single command

I. Thermal IP Cameras

1. Video Requirements:

a. Provide cameras capable of simultaneously delivering at least two individual video streams, for use when connecting to the Video Management Software for recording and live viewing.

b. Provide cameras with a primary stream capable of supporting the video resolution and aspect ratio and capable of generating the image framerates noted in this section.

c. By generating a secondary stream at fractional resolutions of the primary stream, Video device must support Pelco Smart Compression.

2. Encoding Requirements:

a. Support compression and image quality settings from 1 to 20 to configure bandwidth utilized by the camera and desired image response. Provide user configuration of compression quality and image rate per camera.

b. Provide simultaneous H.265 and H.264 or Motion JPEG and H.264 streams (multi-stream).

c. Support Motion JPEG encoding up to 15fps on cameras with 30Hz sensor, or 8.6fps on cameras with 9Hz sensor, based on resolution configured.

d. Support H.264 encoding in a selectable range from 1 up to 30 frames per second based on resolution configured.

e. Support motion compensation and motion vector during motion estimation in H.264, able to maintain frame rate, regardless of scene complexity, when bandwidth is capped at 12 mbps at 30 Frames per second.

f. Provide user configuration of compression format, compression quality, maximum bit rate, key frame interval, and image rate per camera.

g. Support G.711 PCM 8kHz audio compression.

3. Provide cameras that allow video and audio signals to be transported over:

a. HTTP (Unicast).

b. HTTPS (Unicast).

c. RTP (Unicast & Multicast).

d. RTP over RTSP (Unicast).

e. RTP over RTSP over HTTP (Unicast).

f. RTP over RTSP over HTTPS (Unicast).

4. Camera Sensor Requirements:

a. Minimum Dynamic Range: -40 °C to 225 °C (-40 °F to 437 °F)

b. Pixel Pitch: 12µm

c. Spectral Range: 8µm to 14µm

d. Sensitivity: NETD <50mK

e. Support for Image Uniformity Optimization

5. Image Control Requirements:
    a. User Configurations Supported:
        1) Motion detection sensitivity and threshold.
6. Adaptive Video Analytics Specifications:
    a. Include detection of the following behaviors:
        1) Objects in Area
        2) Object Loitering
        3) Objects Crossing Beam
        4) Object Appears or Enters Area
        5) Object Not Present in
        6) Objects Enter Area
        7) Objects Leave Area
        8) Object Stops in Area
        9) Direction Violated
        10) Tamper Detection
7. Radiometric Analytics Specifications:
    a. Upon the selection of activity tracking temperature threshold the device will constantly monitor changes in the scene.
    b. Include detection of the following behaviors:
        1) Maximum temperature of ROI exceeds specified value.
        2) Maximum temperature of ROI matches specified value.
        3) Maximum temperature of ROI falls below specified value.
        4) Average temperature of ROI exceeds specified value.
        5) Average temperature of ROI matches specified value.
        6) Average temperature of ROI falls below specified value.
        7) Minimum temperature of ROI exceeds specified value.
        8) Minimum temperature of ROI matches specified value.
        9) Minimum temperature of ROI falls below specified value.
        10) Selected spot temperature exceeds specified value.
        11) Selected spot temperature matches specified value.
        12) Selected spot temperature falls below specified value.

13) Maximum temperature increase of the ROI exceeds specified value.

14) Maximum temperature decrease of the ROI exceeds specified value.

15) Average temperature increase of the ROI exceeds specified value.

16) Average temperature decrease of the ROI exceeds specified value.

17) Minimum temperature increase of the ROI exceeds specified value.

18) Minimum temperature decrease of the ROI exceeds specified value.

19) Selected spot temperature increase exceeds specified value.

20) Selected spot temperature decrease exceeds specified value.

8. Network Requirements: Provide video cameras that have the following network capabilities:

a. Supports both fixed (static) IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.

b. Supports user configuration of network parameters including:

1) Fixed (static) IP address.

2) Subnet mask.

3) Gateway.

4) Control port.

5) Are automatically detected when using a Video Management Application (VMA) or Network Video Recorder (NVR) supporting this feature.

6) Provides support for both IPv4 and IPv6 Networks.

9. Video Motion Detection Functionality Requirements: Provide video cameras capable of detecting motion based on:

a. Motion Detection Mask: Defined areas within the camera's field of view for the camera to detect motion.

b. Sensitivity: How much each pixel within the masked areas must change before it is considered in motion.

c. Threshold: Percentage of pixels that must detect change.

10. Event Functionality Requirements: Equip cameras with an integrated event functionality, which may be triggered by:
    a. Alarm input terminal.
    b. Video motion detection.
    c. Detection analytics rule activation.
    d. Radiometric analytics rule activation.
11. Protocol Support Requirements: Provide video cameras that incorporate support for at least the following:
    a. SNMP v2c.
    b. SNMP v3.
12. Streaming Support Requirements: Provide video cameras that incorporate support for at least the following:
    a. RTP/UDP.
    b. RTP/UDP multicast.
    c. RTP/RTSP/TCP.
    d. RTP/RTSP/HTTP/TCP.
    e. RTP/RTSP/HTTPS/TCP.
    f. HTTP.
13. Video Overlay Requirements: Provide video cameras with the following overlay requirements:
    a. 64 individually configurable privacy zones to conceal defined areas in image as non-viewable.
    b. Video masked by privacy zones must be obscured prior to streaming.
14. Security Requirements: Provide video cameras with the following security requirements:
    a. Support the use of the following:
        1) Password protection.
        2) HTTPS Encryption.
        3) Digest authentication.
        4) WS authentication.
        5) User access Log.
        6) SSL encryption.
        7) 802.1x port-based authentication.

b. Restrict access to the built-in internet server by usernames and passwords at three different user group levels.

15. Electrical Power: Cameras capable of being powered by the following power sources:
    a. Power Consumption: 10W.
    b. PoE: up to IEEE 802.3af Class 3 PoE Compliant.
    c. AC Power: 24 V +/- 10%, 15W.
    d. DC Power: 12 V +/- 10%, 9W.
    e. Battery Backup: 3V manganese lithium.
16. Installation and Maintenance Requirements: Provide video cameras with the following installation and maintenance requirements:
    a. Allow firmware updates via network.
    b. Store customer-specific settings in a non-volatile memory which cannot be lost during power cuts or soft reset.
    c. Provide Microsoft Windows based management software, allowing camera configuration, upgrade of firmware, and backup of individual camera configurations.
17. Diagnostics:
    a. Equipped with LEDs, indicating the camera's functional status, which may be user enabled or disabled.
    b. Monitored by functionality which automatically reinitiates processes or restarts the unit if a malfunction is detected.
18. Connectivity:
    a. 100BASE-TX Fast Ethernet-port with RJ-45 socket, auto negotiation of network speed and transfer mode.
    b. Terminal for receiving line level analog audio from an external microphone.
    c. Terminal for providing line level analog audio for connection to an external speaker.
    d. USB 2.0 Port.
    e. Onboard Storage: microSD/microSDHC/microSDXC slot – video speed class required; class V10 or better recommended.
19. Operational Range:
    a. Temperature: -40 degrees C to +65 degrees C [40 F to +149 F].
    b. Relative Humidity: 0–93 percent (non-condensing).

20. Construction: Surface mounted with tamper and vandal resistant aluminum housing; powder coated, grey.
    a. Dimensions: 312 mm x 126 mm x 104 mm (12.3 inches x 5 inches x 4.1 inches) including junction box, mounting bracket and fully extended sunshield overhang.
21. Thermal Bullet Camera with 4.3mm focal length:
    a. Basis of Design Product: SXTE4-QF04-EBT, by Pelco.
    b. Performance:
        1) Lens: 4.3mm, F1.0, Athermalized.
        2) Resolution: 320x256.
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 30 fps.
        6) Resolution Scaling: May be scaled up to 640x512.
        7) Angle of View: 50 degrees x 40 degrees.
        8) Listed Classified Object Detection Range.
            a) Human: 68m (224 feet).
            b) Vehicle: 80m (263 feet).
22. Thermal Bullet Camera with 4.3mm focal length:
    a. Basis of Design Product: SXTE4-QF04-EBT-1, by Pelco.
    b. Performance:
        1) Lens: 4.3mm, F1.0, Athermalized.
        2) Resolution: 320x256.
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 8.6 fps.
        6) Resolution Scaling: May be scaled up to 640x512.
        7) Angle of View: 50 degrees x 40 degrees.
        8) Listed Classified Object Detection Range.
            a) Human: 68m (224 feet).
            b) Vehicle: 80m (263 feet).
23. Thermal Bullet Camera with 9.1 mm focal length:
    a. Basis of Design Product: SXTE4-QF09-EBT, by Pelco.

b. Performance:

24. Lens: 9.1mm, F1.0, Athermalized.
    a. Resolution: 320x256.
    b. Image Sensor: Uncooled VOx Microbolometer.
    c. Aspect Ratio: 5:4.
    d. Imaging Rate: 30 fps.
    e. Resolution Scaling: May be scaled up to 640x512.
    f. Angle of View: 24.1 degrees x 19.2 degrees.
    g. Listed Classified Object Detection Range.
        1) Human: 120m (394 feet).
        2) Vehicle: 130m (426 feet).
25. Thermal Bullet Camera with 9.1 mm focal length:
    a. Basis of Design Product: SXTE4-QF09-EBT-1, by Pelco.
    b. Performance:
        1) Lens: 9.1mm, F1.0, Athermalized.
        2) Resolution: 320x256.
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 8.6 fps.
        6) Resolution Scaling: May be scaled up to 640x512.
        7) Angle of View: 24.1 degrees x 19.2 degrees.
        8) Listed Classified Object Detection Range.
            a) Human: 120m (394 feet).
            b) Vehicle: 130m (426 feet).
26. Thermal Bullet Camera with 13.8 mm focal length:
    a. Basis of Design Product: SXTE4-QF13-EBT-1, by Pelco.
    b. Performance:
        1) Lens: 13.8 mm, F1.0, Athermalized.
        2) Resolution: 320x256
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 8.6 fps.

6) Resolution Scaling: May be scaled up to 640x512.
7) Angle of View: 16 degrees x 12.8 degrees.
8) Listed Classified Object Detection Range.
a) Human: 180m (590 feet).
b) Vehicle: 190m (623 feet).

27. Thermal Bullet Camera with 18 mm focal length:
a. Basis of Design Product: SXTE4-QF18-EBT, by Pelco.
b. Performance:
1) Lens: 18 mm, F1.0, Athermalized.
2) Resolution: 320x256.
3) Image Sensor: Uncooled VOx Microbolometer.
4) Aspect Ratio: 5:4.
5) Imaging Rate: 30 fps.
6) Resolution Scaling: May be scaled up to 640x512.
7) Angle of View: 12.2 degrees x 9.7 degrees.
8) Listed Classified Object Detection Range.
a) Human: 220m (722 feet).
b) Vehicle: 225m (739 feet).

28. Thermal Bullet Camera with 18 mm focal length:
a. Basis of Design Product: SXTE4-QF18-EBT-1, by Pelco.
b. Performance:
1) Lens: 18 mm, F1.0, Athermalized.
2) Resolution: 320x256.
3) Image Sensor: Uncooled VOx Microbolometer.
4) Aspect Ratio: 5:4.
5) Imaging Rate: 8.6 fps.
6) Resolution Scaling: May be scaled up to 640x512.
7) Angle of View: 12.2 degrees x 9.7 degrees.
8) Listed Classified Object Detection Range.
a) Human: 220m (722 feet).
b) Vehicle: 225m (739 feet).

29. Radiometric Bullet Camera with 9.2 mm focal length:
    a. Basis of Design Product: SXRE4-VF09-EBT, by Pelco.
    b. Performance:
        1) Lens: 9.2 mm, F1.0, Athermalized.
        2) Resolution: 640x512
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 30 fps.
        6) Resolution Scaling: May be scaled down to 320x256.
        7) Angle of View: 49.9 degrees x 39.3 degrees.
        8) Listed Classified Object Detection Range.
            a) Human: 120m (394 feet).
            b) Vehicle: 142m (466 feet).
30. Radiometric Bullet Camera with 9.2 mm focal length:
    a. Basis of Design Product: SXRE4-VF09-EBT-1, by Pelco.
    b. Performance:
        1) Lens: 9.2 mm, F1.0, Athermalized.
        2) Resolution: 640x512
        3) Image Sensor: Uncooled VOx Microbolometer.
        4) Aspect Ratio: 5:4.
        5) Imaging Rate: 8.6 fps.
        6) Resolution Scaling: May be scaled down to 320x256.
        7) Angle of View: 49.9 degrees x 39.3 degrees.
        8) Listed Classified Object Detection Range.
            a) Human: 120m (394 feet).
            b) Vehicle: 142m (466 feet).
31. Radiometric Bullet Camera with 14 mm focal length:
    a. Basis of Design Product: SXRE4-VF14-EBT, by Pelco.
    b. Performance:
        1) Lens: 14 mm, F1.0, Athermalized.
        2) Resolution: 640x512.
        3) Image Sensor: Uncooled VOx Microbolometer.

4) Aspect Ratio: 5:4.
5) Imaging Rate: 30 fps.
6) Resolution Scaling: May be scaled down to 320x256.
7) Angle of View: 32 degrees x 25.6 degrees.
8) Listed Classified Object Detection Range.
a) Human: 165m (541 feet).
b) Vehicle: 185m (607 feet).

32. Radiometric Bullet Camera with 14 mm focal length:
a. Basis of Design Product: SXRE4-VF14-EBT-1, by Pelco.
b. Performance:
1) Lens: 14 mm, F1.0, Athermalized.
2) Resolution: 640x512.
3) Image Sensor: Uncooled VOx Microbolometer.
4) Aspect Ratio: 5:4.
5) Imaging Rate: 8.6 fps.
6) Resolution Scaling: May be scaled down to 320x256.
7) Angle of View: 32 degrees x 25.6 degrees.
8) Listed Classified Object Detection Range.
a) Human: 165m (541 feet).
b) Vehicle: 185m (607 feet).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Labeling

1. Electrical devices, conduit and wiring shall be identified in accordance with Section 26 05 53 – Identification for Electrical Systems.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Factory testing of video surveillance equipment shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. Factory shop test reports shall be submitted.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Verification of Conditions: Do not begin installation until substrates have been properly prepared.

B. Evaluation and Assessment: If substrate preparation is the responsibility of another installer, notify the City or its authorized representative of unsatisfactory preparation before proceeding.

C. Surface Preparation: Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions.

3.02 INSTALLATION

A. Drawings and Instructions

1. Install video surveillance system as indicated on the Drawings, in accordance with the manufacturer's diagrams and printed instructions, except where otherwise indicated.

B. Wiring

1. Wiring for systems shall be installed in conduit. Provide conduit as specified in Section 26 05 33 - Raceways and Boxes for Electrical Systems.

2. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.

3. The conductors for the video surveillance system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems.

4. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit.

5. Gutter space to accommodate all necessary wiring shall be provided.

C. Systems Integration

1. Products listed in this section to be pre-installed with the most up-to-date firmware, or a version as specified by the provider.

2. Contractor to review configurable features of the device with the Owner’s Representative and establish a punch list for standard, device specific, location specific and VMA/NVR specific configuration of device(s). The Contractor will install, program and configure devices in accordance with this punch list such that no additional programming is required by the user.

3. All equipment requiring users to log on using a password to be configured with user or site-specific passwords. No default passwords may remain active within the system.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Notify the City or its authorized representative 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the City or its authorized representative. Tests shall include testing of interfaces with RTU-9130 Telemetry Panel and remote DEP monitoring facility, as specified in Section 40 80 82 – PMCS Startup and Field Testing.

2. Submit detailed test reports for all testing required in this Section. Furnish instruments and personnel required for the tests.

3. Verify that the system is free of grounds or open circuits. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized.

4. Test equipment and configure system in accordance with instructions provided by the manufacturer prior to installation.

5. Review configurable features of the device with the Owner's Representative and establish a punch list for standard, device specific, location specific and VMA/NVR specific configuration of device(s).

6. Program and configure devices in accordance with this punch list so no additional programming is required for operation by the user.

7. Configure equipment requiring users to log on using a password with user/Site-specific credentials. Default passwords are not acceptable and must be configured prior to Project Closeout.

8. Provide products with the latest and most up-to-date firmware by the manufacturer or provide firmware of a version specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).

B. Manufacturer's Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the Video Surveillance System, check the Video Surveillance System installation before it is placed into operation and assist in the performance of Preliminary and Final Field Tests.

2. The Manufacturer's representative shall provide Video Surveillance System equipment Start-up services and Training of the Contractor and the City's operations and maintenance staff in the care, operation, and maintenance of the Video Surveillance System in accordance with this Section, the Contract Documents, and the following requirements:

a. Minimum number of manufacturer's representative Site visits per Video Surveillance System:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation Supervision	2	1	2
Installation Inspection	2	1	2
Field Testing	2	2	4
Startup	1	2	2
Training	1	2	2

b. Additional trips or days that are required to achieve the proper installation, operation or training, such services shall be arranged for by the Contractor at no additional cost to DEP.

c. The Engineer shall have the right to reallocate any unused time

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.

b. The Video Surveillance System manufacturer’s representative shall certify in writing to the Engineer that the Video Surveillance System equipment has been installed, setup and tested properly in accordance with Contract requirements and is operating at optimum conditions and capacity.

4. The manufacturer representative shall also make any necessary adjustments and instruct the Site personnel in its operation and maintenance.

5. The service representative shall sign in and out with the Engineer on each day they are at the Site.

6. A day shall be understood to be the actual time spent at Site and does not include travel to and from the Site.

C. Quality Control

1. Quality assurance inspections shall be in accordance with the requirements of with Section 01 43 10 – Quality Assurance Inspections.

2. System tests to be performed under the supervision of a qualified representative and the AHJ.

3. Perform all tests to verify the correction of defects found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform work at no additional cost to the City and retest the system.

3.04 STARTUP / DEMONSTRATION

A. Startup

1. Video Surveillance System startup shall comply with the requirements of Section 01 79 05 – Equipment Start-up and Training and Section 40 80 82 – PMCS Startup and Field Testing and shall be considered completed when all cameras and components of the Video Surveillance System complete their startup requirements.

B. Demonstration:

1. Demonstrate administration and operation of devices described by this section.
2. Demonstrate how to authorize users and applications to operate and configure installed devices.
3. Demonstrate how an authorized user can gain access to and make changes to configuration.
4. Demonstrate how to operate functionality configured for this Project as defined by configuration punch list, including interfacing with RTU-9130 Telemetry Panel and the remote DEP monitoring facility.

C. Training

1. The Contractor shall provide Training on the Video Surveillance System in compliance with Section 01 79 05 – Equipment Start-up and Training.
2. The Contractor shall submit for approval by the Engineer, lesson plans identifying in detail, the training to be conducted.
3. Training shall include the receipt, handling and acknowledgment of alarms.
4. System operation training shall demonstrate manual control of output functions from the system control panel.
5. The Contractor shall coordinate training services with the City and the Engineer.
6. The Contractor shall schedule training at least forty-five (45) days prior to delivery of training subject to the approval of the Engineer and the City.
7. The training shall consist of both classroom and field instruction.
8. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any control switches and other equipment required for operation; and to identify locations of any maintenance equipment.
9. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting / Fine Tuning:

1. Perform field software changes after initial programming session to “fine tune” operating parameters and sequence of operations based on any revisions to Owner’s operating requirements.

B. License Assignment:

1. Register software, hardware, firmware, operational or administrative licenses necessary for to operate or administer devices to Owner.

2. Deliver to Owner’s Representative proof of license registration from product manufacturer.

C. Device Configuration Backup:

1. Using manufacturer’s backup software tool or VMA/NVR, perform a full system back-up at completion of initial programming.

2. Deliver configuration backup files, restoration application and instructions detailing for restoration of back-up configuration.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 28 31 00 - FIRE DETECTION AND ALARM

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall design, furnish, install, test and place into satisfactory operation Fire Detection and Alarm System for the Contract PS-318 as specified herein and in compliance with the Contract Drawings and all applicable codes and standards listed in this section for the following buildings and enclosures:

1. Paerdegat Pumping Station Building

2. Standby Generator Outdoor Walk-in Enclosure.

B. The fire alarm and detection system shall be microprocessor based, UL listed, FDNY-approved, addressable supervised fire detection and alarm system as indicated and specified.

C. The System shall include, but not be limited to: Main Fire Alarm Control Panel (FACP) remote Fire Alarm Annunciator Panels (FAAP), power supplies and fire alarm initiating and notification devices including addressable monitor and control relay modules as indicated on the Contract Drawings.

D. The fire alarm system shall include conduit, wire, fittings, and all required system accessories required to provide a complete operating system.

E. Connect the FACP and FAAPs in a local area network via twisted pair cable for data communication. Display system information including system status, network status, alarms, trouble, and supervisory indications at the FACP and each FAAP.

F. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	5
1.07	Submittals	6
1.08	Delivery, Storage and Handling	8
1.09	Spare Parts	8
1.10	Special Warranty Provisions / Guarantee Periods	9
PART 2	PRODUCTS	9
2.01	Manufacturers	9
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	19
2.04	Source Quality Control / Shop Tests	19

PART 3 EXECUTION.....20
3.01 Examination / Preparation.....20
3.02 Installation.....20
3.03 Field Testing / Quality Control.....21
3.04 Startup / Demonstration 23
3.05 Adjusting / Protection / Cleanup.....24

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 43 10 – Quality Assurance Inspection

C. Section 01 65 00 – Product Delivery Requirements

D. Section 01 78 24 – Spare Parts and Maintenance Materials

E. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.04 REFERENCES

A. Factory Mutual (FM):

1. P7825: Approved Guide

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits.

2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

2. 72: National Fire Alarm Code

3. 90A: Standard for the Installation of Air Conditioning and Ventilating Systems

4. 101: Life Safety Code.

D. Underwriters' Laboratories (UL)

1. Fire Protection Equipment Directory

2. 268: Standard for Smoke Detectors for Fire Alarm Signaling Systems

3. 464: Standard for Audible Signal Appliances
4. 864: Control Units for Fire Protective Signaling Systems
5. 1971: Signaling Devices for the Hearing Impaired

E. State and Local Building Codes.

1. NYC Building Code
2. NYC Electrical Code
3. NYC Fire Code
4. NYC Mechanical Code

1.05 DESCRIPTION

A. Type of System:

1. Fire Alarm System: The fire alarm system shall operate as a low voltage addressable type system and shall automatically be placed into an alarm condition whenever any manual or automatic fire detecting devices or monitor modules are placed into an alarm mode. The system shall indicate areas of alarm and sound local alarms at the FACP and each FAAP as indicated on the Contract Drawings.
2. The system shall be capable of operating with a single break or ground fault condition in the initiating, notification, and data communication circuits.
3. The data communication network between the FACP and FAAPs shall utilize Class A wiring as described in NFPA 72. The data communication network shall utilize wiring type as recommended by the manufacturer.
4. Signaling line circuits for initiating devices, monitor modules, control relay modules and any other required addressable devices shall utilize Class X wiring as described in NFPA 72. Notification appliance circuits for horns, strobes, speakers and any other notification appliances shall utilize Class A wiring as described in NFPA 72.
5. Power Supply for the System: The power supply for the FACP shall be provided in accordance with NYC Electrical Code 760.33 and 760.41. Power shall be tapped from ahead of the building or enclosure service disconnecting means as indicated on the Contract Drawings and per all applicable requirements of NYC Electrical Code 760.33 and 760.41. The FACP shall have a manufacturer provided battery backup system consisting of rechargeable, sealed type storage batteries and battery charger. Additional external power supplies required by the system at the discretion of the fire alarm system manufacturer or due to circuit load or length shall be provided from the same aforementioned tap as the FACP via fused cutouts and/or fused disconnect switches. Automatic transfer switches (ATS) dedicated solely for the fire alarm system shall be independently wired to initiate start of black start generator upon loss of normal source

where the black start generator serves as the alternate source. Each FAAP shall be provided power from a PLFA 24VDC power supply located within the FACP enclosure.

6. The system shall interface to HVAC system, fire suppression systems, standby generator systems and other building systems using monitor modules and control relay modules as shown on the Contract Drawings and as required by all applicable codes listed in this Section to provide all required monitoring and control functions.

B. Sequence of Operation:

1. When a fire-alarm condition is detected by one of the system's initiating devices, the following functions shall immediately occur:

   a. Automatic programs assigned to the alarm point shall be executed and the associated indicating devices and relays activated.

   b. Fire-alarm notification devices in the building shall operate.

   c. An exterior strobe at the building in alarm shall energize and the fire alarm notification devices in only that building shall operate.

   d. The system alarm on the FACP and each FAAP will indicate condition.

   e. The alarm shall be signaled automatically to the designated Central Station Monitoring System.

   f. Shutdown of all HVAC equipment and any defined exhaust and pressurization operations to be initiated.

   g. Refer to Contract Drawings for detailed sequence of operation.

2. When a trouble or supervisory condition is detected by one of the system's initiating, indicating circuits, or upon loss of AC power the following functions shall immediately occur:

   a. System Trouble or Supervisory will be indicted on FACP and Annunciator Command Center.

   b. A local trouble-sounding device in the FACP and at each FAAP shall be activated. This sound shall be distinct from the alarm sound.

   c. Refer to Contract Drawings for detailed sequence of operation.

3. Fire Suppression Systems shall be monitored by the fire alarm system as indicated on the Contract Drawings and as follows:

   a. Each Fire Suppression System shall be monitored for alarm, supervisory, trouble, discharge zone 1, and discharge zone 2 signals using monitor modules.

   b. Upon an alarm, supervisory, trouble, or discharge condition the FACP and each FAAP shall display the condition as noted in items

1 and 2 above and as per the detailed sequence of operation on the Contract Drawings.

c. Refer to Contract Drawings for detailed sequence of operation.

4. Standby Generator system shall be monitored by the fire alarm system as indicated on the Contract Drawings and as follows:

a. Standby Generator system shall be monitored for status (generator running, generator failure to start) using monitor modules.

b. Generator fuel systems shall be monitored for leak using monitor modules.

1.06 QUALITY ASSURANCE

A. Comply with the requirements specified in Section 01 43 10 – Quality Assurance Inspection.

B. Standard Products: Material and equipment shall be the latest standard products of a single manufacturer regularly engaged in the manufacture of the product for the 5 years as a minimum.

C. Qualifications of the installer before commencing work: Submit information demonstrating that the supplier has successfully installed fire alarm systems of the same scope, type and design as specified.

1. Submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

2. Employ on staff a minimum of one full time NICET level IV Technicians or a Professional Engineer.

3. Certify that the completed system conforms with UL standards upon completion of the installation.

4. Ongoing maintenance and testing shall be provided to the City under a maintenance contract to maintain the UL listing.

D. Nameplates: The components of equipment shall have the manufacturer's name, address, type or style, contract tag number and catalog number on a plate securely attached to the equipment.

E. Tags: Tags with stamped identification number shall be furnished for keys and locks. Tags shall be furnished to identify cable and conduit runs, wiring circuits, and all spare parts furnished for Authority's stock to maintain the system.

F. Keys and Locks: All locks shall be keyed alike.

G. Verification of Dimensions: Become familiar with details of the Work and verify dimensions in the field.

H. Compliance: The fire detection and internal alarm system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or approved in accordance with the applicable NFPA standards.

I. Accessibility: Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units, and allow ample gutter space for interconnections of panels and field wires.

J. Verify conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier.

K. Review selected arrangement with local fire authority for conformance with local and state requirements.

L. Onsite Technician Services:

1. Provide the services of a representative or technician certified by the manufacturer of the system, experienced in the installation and operation of the type of system provided.

2. The representative shall be licensed in the State if required by law.

3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system, and Underwriters Laboratories listing certification requirements.

4. The technician shall provide the required instruction to the City's personnel in the system operation, maintenance and programming.

5. Provide services of the manufacturer's service representative during installation, startup and testing, for a period of three working days plus travel where a working day is equivalent to 8 hours.

1.07 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

1. Copy of this Section with addenda and all referenced Contract Sections with addenda check-mark each paragraph to indicate specification compliance or indicate deviation and reason for deviation.

a. Failure to include a copy of the marked-up Contract Sections will result in return of the entire submittal with no further review and consideration.

2. Installer and system supplier qualifications and list of three similar projects with name and phone number of contact person.

3. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop Drawings shall contain complete conduit riser diagrams, wiring diagrams, plan layout drawings, schematic diagrams and sequence of operations for all equipment, devices, conduits and cables furnished. Riser diagrams shall

identify cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

4. Manufacturer's printed installation instructions.

5. Battery capacity calculations to demonstrate that the battery size selected is a minimum of 125 percent of the calculated requirement. Calculation to include supervisory power requirements for all equipment, and alarm power requirements for all equipment.

   a. Calculations to show amplifiers have sufficient capacity to simultaneously drive fire alarm speakers at their 1/2 watt tap plus 50 percent spare capacity.

6. Wiring diagrams from the fire alarm system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.

7. Voltage drop calculations based on field measured wiring distances indicating that signaling and notification appliance circuits do not exceed the manufacturer's recommended maximum voltage drop for each type of circuit.

B. Spare Parts Data:

1. After approval of the list of shop drawings, and not later than six months prior to the date of substantial completion, furnish copies of spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies with current unit prices and source of supply, a list of supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified to be furnished in accordance with paragraph Special Tools and Spare Parts and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days.

C. Operating and Maintenance Instruction Manuals:

1. Upon approval of submittals required in 1.04.A and prior to the end of project, submit operating instruction manuals as specified in 01 78 25 – Operations and Maintenance Manuals, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and detailed description of all equipment and their basic operating features. The operating instruction manuals shall include all approved riser, plan, wiring and schematic drawings as well as detailed sequence of operations tables.

2. Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.

3. Performance Test Reports: Upon completion of the installed system, submit in field tests performed to prove compliance with the specified performance criteria and as detailed in Part 3 of this Section.

D. Submit Certificate of Compliance, signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

E. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings and approved Shop Drawings as needed to depict component locations and wiring to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Upon receipt of approval, resubmit all impacted submittals required to make clarifications or revisions to obtain approval.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 01 65 00 – Product Delivery Requirements.

B. Equipment placed into storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Comply with the requirements specified in Section 01 78 24 – Spare Parts and Maintenance Materials.

B. Provide one spare FACP motherboard and one spare of each FACP enclosure component including but not limited to signal circuit cards, notification circuit cards, network interface cards, and PLFA power supplies. At a minimum provide an additional 10 percent quantity (or minimum of 2) of each initiating device type, notification device type, control relay module and monitor module. The manufacturer shall also submit a list of recommended spare parts to be furnished for review by the Engineer.

C. Three sets of all special tools necessary for the maintenance of the equipment shall be furnished. The list of special tools to be furnished shall be submitted for review by the Engineer. Two spare sets of fuses of each type and size required and five spare lamps for each type shall be furnished. Spare parts shall be listed on submittal list.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

B. The Contractor shall provide a warranty from the equipment manufacturer, warrantying all equipment furnished under this Section against defects in workmanship and material for a period of twenty-four (24) months from the date of Substantial Completion. The warranty shall include the following:

1. All costs for labor, transportation, freight and replacement parts required to satisfactorily repair any piece of equipment as a result of equipment malfunction during the warranty period.

2. A report shall be submitted after each site visit describing the problem, solution, all work performed, and parts replaced.

3. All work shall be performed by the equipment manufacturer or authorized representative.

C. The cost of this warranty shall be included in the lump sum price bid for the Contract.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Fire Finder XLS

B. Honeywell

C. Simplex – Grinnell

D. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. General Product Description:

1. Each Fire-Alarm Control Panel (FACP) shall be capable of fire detection, equipment supervision, data/network communication and control, alarm management, and historical data collection and archiving. The FACP shall have a minimum capacity of 2500 addressable points and 100 notification appliance circuits.

B. Communications:

1. The FACP shall have sufficient memory to support its operating system and databases including:

a. Fire management

b. Alarm management

c. Historical/Trend Data

d. Maintenance Support Applications

e. Custom Processes

f. Operator I/O

2. Communication Ports: Provide data communication ports for simultaneous operation of devices such as industry standard printers, programming terminal, PC, transponder and annunciator.

3. Integrated On-Line Diagnostics: The FACP shall continuously perform self-diagnostics, communication diagnostics and diagnostics on all subsidiary equipment.

4. Surge and Transient Protection: Isolation shall be provided at all field point terminations to suppress induced voltage transients where required. Surge arrestors shall provide protection from all non-signal electrical surges that could cause damage to the equipment. Line surge arrestors shall be isolated from the electrical circuitry that they are protecting.

C. System Software Features:

1. Provide software to form a complete operating system as described in this Section shall be provided.

2. The software programs specified in this section shall be provided as an integral part of the panel and shall not be dependent upon any higher-level computer for execution.

3. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. The control unit shall have capability of performing alarm analysis and signaling. At no time shall the panel's ability to report alarms be affected by operator activity.

4. Status Change Report: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

5. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided.

6. Report Routing: Alarm reports shall be archived for future recall.

7. Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.

8. The FACP shall be capable of storing a library of at least 2500 events.

9. History Mode:

a. The system shall be able to store and display at least 2500 system events that have occurred in a non-volatile buffer memory. Display of these events shall be accomplished on-site through the use of the front control panel indicators and switches.

10. Field Configurable:

a. The system shall be fully configurable and expandable without the need for EPROM programmers. All configurations shall be accomplished through downloading of programs from a computer. Reconfiguration shall not require knowledge of any programming languages or require any special training. All programs shall be stored in non-volatile memory. Entry into program mode shall require a special key and a special password entered into the front panel.

D. Addressable Device Interface:

1. The Addressable Device Interface will be capable of supporting devices as indicated on drawings with minimum 25 percent spare capacity for future devices on each loop as well as 25 percent spare capacity for interface cards within the FACP enclosure.

2. The addressable device interface shall contain its own microprocessor control interfaced with FACP motherboard and operating system software.

3. The addressable device interface shall communicate and provide power to all devices on its loop over a single pair of wires. The fire-alarm system signaling circuits shall function as a Class X system as described in NFPA 72.

4. The addressable device interface board shall receive information from all addressable devices and shall process this information to determine normal, alarm, or trouble conditions. The information shall also be used for automatic test and determination of maintenance requirements.

5. Communication with connected devices shall be performed every 5 seconds or less. Average time to detect an alarm shall be less than 10 seconds (longer for alarm verification detectors).

E. Notification Appliance Circuit:

1. The FACP shall provide supervised Class A notification circuits as indicated on Contract Drawings with 25 percent spare capacity for future devices on each circuit and 25% spare capacity of notification circuit cards/interface boards within the FACP. The circuit capacity shall be 2.0 amperes maximum per circuit, maximum of 8.0 amperes from the FACP's power supply. If a short-circuit trouble occurs on one of the circuits, it shall not affect the operation of the remaining circuits. The manufacturer shall submit notification appliance circuit calculations showing load of each

circuit and field setting of each visual (cd) or audio (dBA) device on the circuit.

F. Amplifiers, Preamplifiers, Tone Generators:

1. Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a fire alarm control unit, terminal cabinet, or in the fire alarm control panel. The system shall automatically operate and control all building fire alarm speakers except those installed in the stairs and within elevator cabs. The speakers in the stairs and elevator cabs shall operate only when the microphone is used to deliver live messages. Each amplifier shall have two channels; one to broadcast a message and the other for paging.

a. Construction: Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

b. Inputs: Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

c. Tone Generator: The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a slow whoop tone, which shall slowly ascend from low (500 Hertz) to high (1200 Hertz), and shall be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. Each slow whoop cycle shall last approximately 4 seconds. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator cause the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.

d. Protection Circuits: Each amplifier shall be constantly supervised for any condition which could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual “amplifier trouble” indicator on the control panel, appropriate logging of the condition of the system printer, and other actions for trouble conditions as specified.

G. Function Relays:

1. The FACP shall provide a minimum of four (4) Form "C" relay contacts, rated at 2 A at 120 VAC. These relays may be programmed to activate on alarm from any initiating zone or any combination of initiating zones, analog devices or addressable modules, or trouble and supervisory signals.

H. Central Processing Unit (CPU):

1. The CPU shall communicate with the operator interface, LCD display, LED display and control other modules in the panel. Removal, disconnection or failure of any control panel shall be detected and reported by the Central Processing Unit.

2. The CPU shall contain and execute all control-by-event programs for specific action to be taken if a fire situation is detected in the system. Such control-by-event programs shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs. The CPU shall also provide a real time clock for time annotation on the display and remote optional printer.

I. Operator Display:

1. The operator display shall provide controls and indicators used by the system operator. The display shall contain, and display as needed, custom alphanumeric message for all intelligent detectors and addressable modules. Such message information shall be stored in programmable non-volatile memory.

2. The display board shall provide a backlit 80-character alphanumeric Liquid Crystal Display (LCD). It shall also have LEDs for system indication such as AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; ACKNOWLEDGE; SIGNAL SILENCE, etc.

3. Factory programmable system indications and keys shall be available for standard unique functions. Keys shall be referred to as "Hot Keys".

4. The Display Interface shall provide a key touch keypad with control capability to command all system functions, and entry of any numeric information. The keypad shall include means to enter a minimum of two different passwords to prevent unauthorized manual control.

5. Ground fault, short circuit, and open circuit indications shall be displayed on an overall system basis as well as by signaling circuit, and notification circuit.

J. Communications Ports:

1. The system shall provide the following communication port interfaces:

a. Network interface cards for FAAPs

b. Digital Alarm Communicator Transmitter (DACT) for connection to designated central station via telephone lines.

c. One port for service and field programming.

d. One port for Printer.

K. Mechanical Design:

1. The Fire Alarm Control Panel (FACP) shall be housed in a cabinet designed for mounting recessed or directly to a wall or vertical surface. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include an opening for viewing.

2. The FACP shall be modular in structure for ease of installation and maintenance.

L. One Person Test Feature: The control unit shall include a special one person test feature, which will allow a single person to test all initiating devices and indicating appliance in a system without returning to the panel to reset the system. A special password shall be required to enter the test mode. The service-technician shall be able to re-select the initiating and indicating circuits that are to be included in the one-person test mode. The Walk-Test shall include a special audible indication that a trouble has been detected on an analog device, for the service-technician to check proper system wiring.

M. Provide addressable monitor modules on signaling circuits to interface FACP to non-addressable detection components and subsystems as required and as indicated on the Contract Drawings. Each module shall be capable of receiving a minimum of one dry contact indication from the component/system being monitored. The modules shall be capable of being mounted in a 4 x 4 x 2 1/8 inches (100 x 100 x 54 mm) junction box.

N. Provide addressable control relay modules on signaling circuits to interface FACP to the DACT, HVAC systems, auxiliary audible and visual devices and other control components as required and as indicated on the Contract Drawings. Each module shall have a minimum of one Form C dry contact capable of sending control inputs to two separate devices/systems. Control relay modules shall have an external LED to indicate when the relay function has been activated. The modules shall be capable of being mounted in a 4 x 4 x 2 1/8 inches (100 x 100 x 54 mm) junction box.

O. Fire-Alarm Initiating Devices:

1. Addressable Devices: All addressable detectors shall:

a. Provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test shall be initiated from the FACP or via a field programmable electronic device communicating with the detectors. All detectors shall have self-diagnostic capabilities and report change in health status to the FACP.

b. Provide address-setting means using the FACP software and a field programmable electronic device. The detectors shall also store an internal identifying code which the FACP shall use to identify the type of detector.

c. Provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

2. Addressable pull stations shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. Pull stations shall use a key operated test-reset lock designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. Operated stations shall have a positive, visual indication of operation and utilize a key type reset. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inch (45 mm) or larger. Mount stations inside a red, weatherproof enclosure with a clear polycarbonate hinged front cover where station is indicated on the drawings as NEMA 4, NEMA 4X and hazardous areas including Class I, Division 1 and 2.

3. Addressable Area Photoelectric Smoke Detectors: Photoelectric Smoke Detectors shall use the photoelectric principle to measure smoke density and shall, on command from the FACP send data to the panel representing the analog level of smoke density. These addressable detectors shall connect via a two-wire signaling circuit to one of the FACP addressable input circuits. Each detector shall utilize a dust-resistant, field cleanable photoelectric detection chamber with microprocessor-based electronics. The detector shall be capable of differentiating between an actual fire and other similar phenomena (i.e. dust, cigarette smoke). A detector with combination photoelectric and heat detection capabilities may also be used.

4. Addressable Heat Detectors: Heat detectors shall use an electronic sensor to respond to temperatures exceeding 135 degrees F (57 degrees C) or 190 degrees F (88 degrees C) as noted on the plans. The sensing element shall be a thermistor or other equivalent electronic heat sensing element. The sensing element shall be capable of being replaced without removing the detector base. The detector shall, on command from the control panel, send data to the panel representing the analog temperature level. These addressable detectors shall connect via a two-wire signaling circuit to one of the FACP addressable input circuits.

5. Each detector shall be provided with a steel mounting plate, and the entire unit shall mount on a double gang electrical box.

6. Addressable Duct Smoke Detectors:

   a. The detectors shall be an air sampling type duct smoke detector and shall be provided with a remote test and alarm indicating station.

   b. The detectors shall, on command from the control panel, send data to the panel representing the analog level of smoke intensity.

7. Provide devices suitable for the area classifications as indicated on the Contract Drawings (i.e., NEMA 1, NEMA 4, NEMA 4X, and NEMA 7 (Class I, Division 1 or 2) NEMA 4X, etc.).

P. Fire Alarm Indicating Devices:

1. Visual appliances shall be installed as shown on the Drawings in accordance with the requirements of the UL 1971 standard and NFPA 72. Where multiple visual signals are visible from any location, circuitry shall be incorporated for the synchronization of the flash rate.

   a. UL 1971 Listed for Emergency Devices for Hearing Impaired in all public mode installations.

   b. Strobes shall meet UL 1971 flash rate.

   c. Visual signals shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.

   d. The strobe intensity shall be rated per UL 1971.

   e. The strobes shall be available for semi-flush or surface mounting and in conjunction with audible signals as required.

   f. Strobes shall have field configurable intensity levels.

2. Audible Devices: Audible evacuation signals shall be provided meeting the following requirements:

   a. Audible Notification appliance shall be electronic and use solid state components.

   b. Each electronic signal shall provide four field selectable alarm tones. The tones shall consist of slow hoop, continuous, temporal or interrupted.

   c. The device shall provide UL dBA measurement at 10 feet (3 m) shall be a minimum of 85 for separately mounted audible signals.

   d. The device shall have provisions for standard reverse polarity type supervision and in/out field wiring using terminals that accept 12 AWG wiring.

e. Combination audiovisual alarm horns shall have a high intensity flashing light and alarm horn as an integral unit. Both audio and visual components shall operate from the 24-volt dc polarized indicating circuits. The horn assembly shall be housed in a rugged, die-cast enclosure, and the electronic light source shall be sealed in silicone and protected by a Lexan lens. The word FIRE shall appear on the lens. Audiovisual alarm devices shall meet the requirements of visual appliances and alarm horns above. Single and/or dual projectors shall be supplied as shown on the plans.

Q. Power Supply:

1. The power supply for the FACP and fire alarm peripherals shall be integral to the FACP. The power supply shall provide FACP and peripheral power needs.

2. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs.

3. Input power shall be 120 VAC, 60 Hertz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be sized as required to meet system requirements. FACP battery system shall meet the requirements of NYC Electrical Code 760.41.

4. The main power supply shall provide a battery charging circuit consisting of a fully automatic standby battery charger, rate compensated, capable of maintaining battery in fully charged state and be capable of recharging batteries to 70 percent of alarm capacity within 12 hours. Provide for normal supervisory operation of entire system for 24 hours followed by full load operation for 15 minutes.

5. Provide charger with the following supervised functions: circuit protection for shorts, open, disconnected or reversed polarity battery connection, supervision or protection of high or low voltage, overcharging and charger failure. Automatic load shedding or battery disconnect on deep discharge to prevent battery damage.

6. Batteries shall be 24-volt, rechargeable, gelled electrolyte, totally sealed, fully charged with al interconnections ready for service, maintenance free, long-life.

R. Wiring within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings:

1. Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet.

2. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks.

3. Mark each terminal in accordance with the wiring diagrams of the system.
4. Make connections with approved pressure type terminal blocks, which are securely mounted.
5. The use of wire nuts or similar devices shall be prohibited.

S. Terminal Cabinets:

1. Provide a terminal cabinet at the base of any circuit riser, and where indicated on the Drawings.
2. Terminal size shall be appropriate for the size of the wiring to be connected.
3. Conductor terminations shall be labeled and a drawing containing conductor, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet.
4. Minimum size is 8 inch (200 mm) high by 8 inch (200 mm).

T. Wiring:

1. Signaling line circuits shall be connected to the FACP with 14 AWG (minimum) twisted shielded pair copper cabling type FPLP NYC certified.
2. Notification appliance circuits shall be connected to the FACP with 12 AWG (minimum) unshielded twisted pair copper cabling type FPLP NYC Certified.
3. Wire size shall be increased beyond the minimum specified sizing to prevent voltage drop problems as required or as deemed appropriate by the fire alarm system manufacturer.
4. Power wiring, operating at 208/120 VAC minimum shall be 12 AWG (minimum) solid copper having 600V insulation. Ground wiring shall be 10 AWG (minimum) solid copper.
5. Provide all wiring in rigid galvanized metal conduit, minimum size 3/4".
6. Outer jacketing for all cables shall be red. Conductor insulation for all pairs shall be red/black.

U. Conductor Terminations:

1. Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection.
2. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation.
3. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal.

4. The laminated drawing shall be neat, using 12-point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

5. Maintain existing color code scheme where connecting to existing equipment.

V. Digital Alarm Communicator Transmitter (DACT):

1. Furnish and install a DACT as indicated on the Contract Drawings. The DACT shall be capable of monitoring multiple dry contact alarms/signals from the FACP and/or addressable control relay modules for notification to the designated central station. The DACT shall be capable of accepting a minimum of two independent analog POTS telephone lines.

W. Fire Alarm Annunciator Panel (FAAP):

1. The remote FAAP shall be a 160 (4 x 40) character back-lit LCD type capable of displaying up to 3200-point messages. The remote annunciator shall have the capability of driving up to 576 LEDs for future graphic notification. They shall be sixteen switch inputs that can be used for various system functions; lamp test, trouble silence, general alarm, scroll, system reset, network reset, etc. All fire-alarm controls shall be operational from the FAAP. Each FAAP shall be provided power from a PLFA 24VDC power supply located within the FACP enclosure.

2. The FAAP shall have non-volatile memory. Annunciators which rely on the FACP for memory will not be accepted.

3. The FAAP shall be surface mounted with switches located with a locked panel, and easily visible through a glass or plastic viewing plate. Panel door shall have a keyed lock identical to the lock on the fire alarm control panel (FACP).

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Painting and Labeling

1. All Fire Alarm cabinets, enclosures, and junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings.

2. Power distribution equipment dedicated to the fire alarm system (fused disconnect switches, transformer, ATS) shall also be painted red and labeled as serving the “Fire Alarm System” with decal or approved markings in accordance with the NYC Building Code and Electrical Code.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Certifications

1. The amended Fire Department Rule 3 RCNY Section 115-01 requires that fire alarm system installation, inspection, testing and servicing must be serviced by an FDNY recognized alarm system installation, inspection, testing and servicing company.

2. The Contractor, and/or the Contractor's Fire Alarm System Subcontractor, shall submit all required certifications, permits and approvals by FDNY and/or AHJ that are valid for the duration of the Work.

3.02 INSTALLATION

A. Drawings and Instructions

1. Install fire alarm system as indicated on the drawings, in accordance with the manufacturer's diagrams and printed instructions, except where otherwise indicated.

B. Wiring

1. Wiring for systems shall be installed in conduit. Provide conduit as specified in Section 26 05 33 - Raceways and Boxes for Electrical Systems.

2. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.

3. The conductors for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems.

4. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit.

5. Gutter space to accommodate all necessary wiring shall be provided.

C. Station Loops

1. Station loops shall be arranged to permit disconnecting and bypassing the system at the base of each riser.

2. External wiring between the control panel and the stations and horns/lights shall connect to terminal strips in accessible locked cabinets.

3. Connections to the terminal strips shall be made with terminal spade lugs or with approved type terminal blocks.

4. Terminal cabinets shall be installed at each point where a station circuit riser originates or any point along a circuit where a tap is made.

D. Panels, Devices and Appliances

1. Panel enclosures shall comply with the requirements of UL 864. Enclosures having doors over 48 inch (1200 mm) in height shall be provided with a three-point catch and lock; all other doors shall contain a cabinet type cylinder lock. Inserts shall be blind fastened so that no screws show on the panel front.

2. Initiating Devices and Notification Appliances shall be installed in accordance with manufacturer's printed instructions.

3. All Fire Alarm cabinets, enclosures, and junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings. Power distribution equipment dedicated to the fire alarm system (fused disconnect switches, transformer, ATS) shall also be painted red and labeled as serving the “Fire Alarm System” with decal or approved markings in accordance with the NYC Building Code and Electrical Code.

4. Review the design drawings and perform a walk-through of all areas with the AHJ.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Notify the AHJ / FDNY and the City 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the City or its authorized representative.

2. Submit detailed test reports for all testing required in this Section. Furnish instruments and personnel required for the tests.

3. Verify that the system is free of grounds or open circuits. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. The FACP shall indicate when a ground or open circuit exists.

4. Alarm initiating devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.

5. Verify that all strobes, audible devices, pull stations, transmitters, automatic detectors and supervisory devices are functioning as specified. Submit a field test procedure for testing the following elements for review and approval by the Engineer.

6. Strobes shall deliver the correct foot-candle. Audible devices shall deliver the correct sound pressure levels decibels of the specified device.

7. Stations shall close the circuits specified and deliver specified alarm codes. Verify central station receives alarm.

8. Automatic detectors shall actuate the specified zones when the appropriate fire or smoke conditions are generated. The detectors shall be exposed to actual smoke and/or heat used to simulate this test on each and every smoke/heat detector as located in the building; no other test will be accepted. The operation of associated control relay modules shall be verified to ensure that the relay module activates upon the appropriate alarm and that the associated equipment being controlled for emergency function (i.e. HVAC units, roll up doors) operates as intended.

9. Panels and supervisory devices shall display and control functions as specified. Loss of AC system power shall also be tested.

10. Close each sprinkler system valve and verify proper supervisory alarm.

11. Verify activation of all water flow switches.

12. Verify monitoring of all points for subsystems including but not limited to the fire suppression, standby generator, PMCS and HVAC systems.

13. Verify emergency shutdown/operation of HVAC units is as per submitted and approved sequence of operations. A HVAC shutdown matrix detailing sequence of operations for each applicable unit under various alarm conditions shall be included in the field test procedure.

B. Manufacturer's Field Services

1. The Contractor shall provide the services of a qualified manufacturer's service representative who shall adequately supervise and assist in the installation of the Fire Detection and Alarm System, check the Fire Detection and Alarm System installation before it is placed into operation and assist in the performance of Preliminary and Final Field Tests.

2. The Manufacturer's representative shall provide Fire Detection and Alarm System equipment Start-up services and Training of the Contractor and the City's operations and maintenance staff in the care, operation and maintenance of the Fire Detection and Alarm System in accordance with this Section, and the Contract Documents and the following requirements:

   a. Minimum number of manufacturer's representative Site visits per Fire Detection and Alarm System:

Construction Phase	No of Visits	Days per Visit	Total Days
Installation Supervision	2	1	2
Installation Inspection	2	1	2
Field Testing	2	2	4
Startup	1	2	2
Training	1	2	2

   b. Additional trips or days that are required to achieve the proper installation, operation or training, such services shall be arranged for by the Contractor at no additional cost to DEP.

c. The Engineer shall have the right to reallocate any unused time

3. The Contractor shall provide a field report from the manufacturer's representative for each visit to the Site.

a. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.

b. The Fire Detection and Alarm System manufacturer's representative shall certify in writing to the Engineer that the Fire Detection and Alarm System equipment has been installed, setup and tested properly in accordance with Contract requirements and is operating at optimum conditions and capacity.

4. The manufacturer representative shall also make any necessary adjustments and instruct the Site personnel in its operation and maintenance.

5. The service representative shall sign in and out with the Engineer on each day they are at the Site.

6. A day shall be understood to be the actual time spent at site and does not include travel to and from the Site.

C. Quality Control

1. Quality assurance inspections shall be in accordance with the requirements of with Section 01 43 10 – Quality Assurance Inspections.

2. System tests to be performed under the supervision of a qualified representative and the AHJ.

3. Perform all tests to verify the correction of defects found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform work at no additional cost to the City and retest the system.

3.04 STARTUP / DEMONSTRATION

A. Startup

1. Fire Detection and Alarm system startup shall comply with the requirements of Section 01 79 05 – Equipment Start-up and Training and shall be considered completed when all the loads on the Fire Detection and Alarm System completes their startup requirements.

B. Training

1. The Contractor shall provide Training on the Fire Detection and Alarm system in compliance with Section 01 79 05 – Equipment Start-up and Training.

2. The Contractor shall submit for approval by the Engineer, lesson plans identifying in detail, the training to be conducted.

3. Training shall include the receipt, handling and acknowledgment of alarms.
4. System operation training shall demonstrate manual control of output functions from the system control panel.
5. The Contractor shall coordinate training services with the City and the Engineer.
6. The Contractor shall schedule training at least forty-five (45) days prior to delivery of training subject to the approval of the Engineer and the City.
7. The training shall consist of both classroom and field instruction.
8. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any control switches and other equipment required for operation; and to identify locations of any maintenance equipment.
9. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 31 09 16.20 - PILE LOAD TESTS, COMPRESSIVE, LATERAL AND UPLIFT LOADS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all equipment, labor, materials and incidental items necessary to perform the pile load tests as shown on the Contract Drawings, specified or otherwise as approved to complete Work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	5
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Implementation	7
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

B. Test piles, drilled in locations where production piles are required and that have passed the load test requirements and have not been loaded to failure, may be incorporated in the structure upon approval by the Engineer, and payment for such Test piles, will be made at the unit price bid for piling work in the Contract.

1.03 RELATED SECTIONS

A. Section 31 63 33 - Drilled Micropiles

1.04 REFERENCES

A. ASTM D1143 - Test Method for Piles Under Static Axial Compressive Load

B. ASTM D3689 - Test Method for Individual Piles Under Static Axial Tensile Load

C. ASTM D3966 - Test Method for Piles Under Lateral Loads

D. New York City Building Code (NYCBC)

1.05 DESCRIPTION

A. Performance Requirements

1. Pile load tests shall conform to the New York City Building Code and this specification. Where the requirements of this specification are more rigorous, they shall be adhered to.

2. The working load of the piles shall be as determined by the Contractor as specified in Section 31 63 33 - Drilled Micropiles, or as shown on the Contract Drawings.

3. Tested piles which pass the load tests and are within tolerance at permanent locations shall be reset for use as permanent piles. The Contractor shall obtain the Engineer's approval for each pile so tested and so reset.

4. Piles which do not meet the requirements for the working load of the piles shall be rejected and additional testing shall be performed on other piles at no additional cost to DEP.

B. Seismic Monitoring

1. When drilling piling, the Contractor shall provide the monitoring stations at locations specified in the relevant pile Specification Sections.

C. Compressive Pile Load Test

1. Compressive pile load tests shall be in accordance with ASTM D1143 and NYCBC, Section 1810.4.1. The load tests at locations shown on the Contract Drawings or specified herein shall be made on test piles placed to the tip elevation and/or drilling resistance used for establishing lengths of piles, unless otherwise directed by the Engineer. Loading, testing and recording of data shall be under the direct supervision of the registered Professional Engineer engaged by the Contractor. A report shall be submitted in accordance with Article 1.06., Submittals.

2. Load Tests:

a. The Contractor shall drill test piles of the same size and materials as the permanent piles. Test piles shall be drilled with the same equipment and in the same manner as the permanent piles.

b. In cases where test piles will develop resistance during testing by non-bearing materials to be excavated, the test pile shall be cased off in that material(s).

c. Permanent piles may be used as reaction piles.

3. The Contractor shall provide all equipment, instruments, personnel, accessories and appurtenances required for the tests. The Contractor shall place reaction piles and beams, as required, to transmit load into the test pile. Calibrated pressure gauges shall be used to determine the actual load placed on the test pile. Calibrations shall have been made within three (3) months of load testing.

a. The Contractor shall prepare complete detailed shop drawings showing how the test will be performed, how the reaction piles will be placed, and how the jacking beams will be anchored to the test piles and the reaction piles.

b. The Contractor's shop drawings shall include date and calibration curves on all instruments and accessories used in the tests.

c. The entire test setup and test procedure shall be subject to the approval of the Engineer.

d. A table of pile loads and test pressures for each test shall be submitted.

e. A foundation stability analysis where dead weights are used for test reactions shall be submitted.

4. Test loads shall be applied by direct weight or by means of a hydraulic jack. The loading platform or box shall be carefully constructed to provide a concentric load on the pile.

a. If direct weight is employed, the loading increments shall be applied without impact or jar. The weight of the loading platform or box shall be obtained prior to the test, and this weight shall be considered as the first increment of load.

b. If a hydraulic jack is employed, equipment for maintaining each increment of desired load constant under increasing settlement shall be provided. The gauge and the jack shall be calibrated as a unit and have a rated capacity to achieve twice the maximum test pile load.

5. The test load shall be twice the proposed working load of the pile. The standard loading procedure of ASTM D1143 shall be used except as follows: the test load shall be applied in 7 increments at a load of 50 percent, 75 percent, 100 percent, 125 percent, 150 percent, 175 percent, and 200 percent of the proposed working load.

a. After the proposed working load has been applied, and for each increment thereafter, the test load shall remain in place until there is no measurable settlement (0.001 inches) in a 2-hour period.

b. The total test load shall remain in place until settlement does not exceed 0.001 foot in 48 hours.

c. The total test load shall be removed in decrements not exceeding 25 percent of the total test load at not less than 1 hour intervals.

d. The rebound shall be recorded after each decrement is removed, and the final rebound shall be recorded 24 hours after the entire test load has been removed.

6. Under each load increment, settlement observations shall be made and recorded at 1/2 minute, 1 minute, 4 minute, and each 4 minutes thereafter after application of load increment, except in the instance of the total load where, after the 4-minute reading, the time interval shall be successively doubled until the final settlement limitation is reached and the load is removed.

7. The maximum allowable pile load shall be such that 50 percent of the applied load shall not cause a net settlement of the pile of more than 0.01 inch per ton of total applied load or shall be 50 percent of the applied load which causes a gross settlement of 1 inch, whichever is less.

D. Pile Lateral Load Tests

1. Pile lateral load tests shall be in accordance with ASTM D3966 and NYCBC, Section 1810.4.3. The load tests at locations shown on the Contract Drawings or specified herein shall be made on test piles placed to the tip elevation and/or drilling criteria used for establishing lengths of piles, unless otherwise directed by the Engineer. Loading, testing and recording of data shall be under the direct supervision of the registered Professional Engineer engaged by the Contractor. A report shall be submitted in accordance with Article 1.10, Submittals.

2. The proposed testing apparatus and structures to be used in making the pile load tests shall be designed by the Professional Engineer engaged by the Contractor. The Contractor shall prepare complete detailed working drawings showing how the lateral load test will be performed including the layout of reaction, jack, and test pile. The drawings shall include date and calibration curves of all equipment and instruments. The entire test setup and procedure will be subject to the approval of the Engineer.

3. Piles shall be tested as free-head piles. Lateral load tests shall be conducted in accordance with Section 6.1 of ASTM D3966 until either 1 inch of gross lateral movement has occurred or the test load has reached 200 percent of the design load. For both cases, the allowable lateral pile load shall be 50 percent of the test value.

a. Reaction for the lateral load test may be an adjacent pile.

b. Movement shall be measured with dial gages to the nearest 0.001 inch referenced to a beam which is supported at least 10 feet away from the test pile and reactions.

c. For H-piles, the direction of the test shall be as specified herein or shown on the Contract Drawings.

E. Pile Uplift Load Tests

1. Pile uplift load tests shall be in accordance with ASTM D3689 and NYCBC, Section 1810.4.2. The load tests at locations shown on the Contract Drawings or specified herein shall be made on test piles placed to the tip elevation and/or drilling resistance used for establishing lengths of piles, unless otherwise directed by the Engineer. Loading, testing and recording of data shall be under the direct supervision of the registered Professional Engineer engaged by the Contractor. A report shall be submitted in accordance with the requirements of this Section.

2. The proposed testing apparatus and structures to be used in making the pile load tests shall be designed by the Professional Engineer engaged by the Contractor. The Contractor shall prepare complete detailed working drawings showing how the uplift load test will be performed including the layout of reaction, jack, and test pile. The drawings shall include date and calibration curves of all equipment and instruments. The entire test setup and procedure will be subject to the approval of the Engineer.

3. Uplift (tensile) load tests shall be conducted in accordance with Section 7.2 of ASTM D3689 until the test load has reached 200 percent of the design load unless failure occurs first. The allowable uplift load shall be 50 percent of the last load increment before failure or of the test load for a completed test.

a. Apply tensile test loads in line with the central longitudinal axis of the pile.

b. Movement shall be measured with dial gages to the nearest 0.001 inch referenced to a beam which is supported at least 8 feet away from the test pile and reactions.

1.06 QUALITY ASSURANCE

A. Qualifications

1. The work shall be performed by the Contractor or a specialty subcontractor employed by the Contractor and having minimum of 5 years of experience in performing pile load tests and installation of the specified piling system under similar subsurface conditions.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Approval by the Engineer shall not relieve the Contractor of his complete responsibility for the adequacy of the pile load test setup. Submittals shall include, but not be limited to:

1. Full description of test method and equipment.
2. Load type and loading equipment.
3. Safety devices.
4. Calibration equipment.

B. The Contractor shall also submit a complete report to the Engineer at the completion of each pile load test. The Contractor shall engage the services of a Professional Engineer, subject to the approval of the Commissioner, licensed in the State of New York, experienced in pile load testing and load test analysis for the supervision of load test procedures and preparation of the report. The report shall include, but not be limited to:

1. Pile identification and location.
2. A description of the pile drilling equipment.
3. Drilling records for both test piles and reaction piles.
4. Complete test data.
5. Analysis of test data.
6. Recommended allowable design loads based on the pile test reports.
7. Description of subsurface conditions.
8. Recommended pile installation criteria.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Compressive Load Testing Apparatus: The proposed testing apparatus and structures to be used in making the pile load tests shall be designed by a Professional Engineer licensed in the State of New York engaged by the Contractor.

1. Load tests shall be performed by a method that will maintain constant concentric load under increasing settlement.

2. Settlement observations shall be made by means of dial extensometers. A minimum of three (3) extensometers shall be used. The extensometers shall provide readings to the nearest 0.001 inch. In addition, settlement observations shall be taken using an engineer's level reading to 0.001 feet properly referenced to a well-established benchmark.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination of the Site

1. Prior to starting operations, an examination of the Site shall be performed in accordance with the relevant pile Specification Sections.

2. Load tests of piles shall be scheduled sufficiently in advance of production pile drilling to prevent delay in the progress of the Work.

3. No production piles shall be drilled until the load test report is approved by the Engineer.

3.02 IMPLEMENTATION

A. Installation of Production Piles

1. The method of installing the permanent piles shall be the same as that used to install the test piles, except where a change in procedure is ordered by the Engineer.

2. The installation procedure established in the test program shall not be changed without the written approval of the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Witnessing

1. The pile installation and test program will be witnessed by the Engineer designated for controlled inspection.

2. The Engineer designated for controlled inspection shall keep records for confirmation of the test pile drilling. The Contractor shall cooperate with the Engineer so that all necessary data may be obtained. The data will include the following:

   a. Type and dimensions of the pile.

   b. Location and pile number.

   c. Type and size of hammer.

   d. Steam or air pressure used to activate hammer.

   e. Type and dimensions of the cushion block.

   f. Actual number of blows per minute delivered by the hammer.

   g. Number of blows required for each foot of penetration, and blows per inch for last six (6) inches.

   h. Elevation of ground.

   i. Elevation to which the pile penetrated under its own weight and under the weight of the hammer.

   j. Final elevation of tip of pile.

   k. Length of delays due to splicing or for any other reason and elevation of pile tip at such time.

   l. Location of pile splices.

   m. Such other information as the Engineer may deem necessary.

3. The Engineer designated for special inspection as required by NYCBC Section 1704 shall be under contract with the owner for the inspection services as required by NYCBC Section 1704.1.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Clean Up

1. Upon completion of the test program, the Contractor shall remove all equipment and remove or cutoff piles not in permanent locations or rejected and restore the Site to a condition satisfactory to the Engineer.

2. Test piles and reaction piles which are drilled at non-permanent pile locations shall be removed or cutoff at least 18 inches below the bottom of the foundation and abandoned.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, tools, equipment, materials and incidental items required to perform Site clearing of all designated areas within the Contract limits and as shown on the Contract Drawings, including Work specified in permits and other agreements, in accordance with the requirements of the Contract Documents

B. The Contractor shall manage and dispose of woody debris potentially infested with harmful agents, including but not limited to Spotted Lanternfly, Dutch elm disease, or Asian Longhorned Beetle, in accordance with all applicable laws and regulations to prevent the spread of such agents, including 7 CFR 301.51 and NYCRR Title 1 Part 139, as applicable to the location of Work. Management of harmful agents may include the performance of site surveys by appropriately qualified professionals and written protocols for the management of any Regulated Articles as directed by the Engineer.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Implementation	10
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	13
3.05	Adjusting / Protection / Cleanup	13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 27 00 - Measurement and Payment

B. Section 31 23 16 - Excavation

C. Section 31 23 23 - Fill

D. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

E. Section 32 90 00 - Planting

F. Section 32 90 05 - Soil Mixes

1.04 REFERENCES

A. Definitions

1. Asian Longhorned Beetle (ALB): The insect known as the Asian Longhorned Beetle (Anoplophora glabripennis) in any stage of development.

2. ALB Compliance Agreement: A written agreement between United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) and a person engaged in growing, handling, or moving regulated articles that are moved within an ALB Quarantine Zone, in which the person agrees to comply with the provisions of 7 CFR 301.51.

3. ALB Limited Permit: A document in which a USDA APHIS inspector affirms that the ALB Regulated Article is eligible for movement only to a specified destination and in accordance with conditions specified on the permit.

4. ALB Regulated Article: The term applies to: (1) Firewood (all hardwood species), and green lumber and other material living, dead, cut or fallen, inclusive of nursery stock, logs, stumps, roots, branches, and debris of half an inch or more in diameter of the following genera: Acer (maple), Aesculus (horse chestnut), Albizia (mimosa), Betula (birch), Celtis (hackberry), Cercidiphyllum (katsura), Fraxinus (ash), Platanus (sycamore), Populus (poplar), Salix (willow), Sorbus (mountain ash), and Ulmus (elm); (2) Any other article, product, or means of conveyance not covered in (1) of this definition if a USDA APHIS inspector determines that it presents a risk of spreading Asian Longhorned Beetle and notifies the person in possession of the article, product, or means of conveyance that it is subject to the restrictions of 7 CFR 301.51. This definition is subject to change and should be verified by consulting 7 CFR 301.51 prior to the start of Work.

5. Caliper: An instrument used to measure the diameter of a tree.

6. Site Clearing: The removal from the ground surface within the designated areas and disposal of trees, brush, shrubs, down timber, decayed wood, other vegetation, rubbish, trash, scrap metal, debris and miscellaneous other structures not covered under other Sections as shown on the Contract Drawings, specified or otherwise required to permit construction of the new Work.

7. Diameter at Breast Height (DBH): A unit of measurement for the diameter of a tree trunk as measured 4 ½ feet above the ground.

8. Grubbing: The removal and disposal of all stumps, buried logs, roots larger than 2 inches, matted roots and organic materials.

9. Spotted Lanternfly (SLF): The insect known as spotted lanternfly (*lycorma delicatula*) in any life stage.

10. SLF Regulated Article: The term applies to: (a) any living life stage of the spotted lanternfly; (b) brush, debris, bark, or yard waste; (c) landscaping, remodeling, or construction waste; (d) logs, stumps, or any tree parts; (e) firewood of any species; (f) packing materials, such as wood crates or boxes; (g) all plants and plant parts including but not limited to nursery stock, green lumber, fruit and produce and other material living, dead, cut, fallen (including stumps), roots, branches, mulch, and composted and non-composted chips; (h) outdoor household articles, including, but not limited to, recreational vehicles, lawn tractors and mowers, mower decks, grills, grill and furniture covers, tarps, mobile homes, tile, stone, deck boards, mobile fire pits, and any equipment associated therewith, and trucks or vehicles not stored indoors; and (i) any other article, commodity, item, or product that has or that is reasonably believed to be infested with or harboring spotted lanternfly. This definition is subject to change and should be verified by consulting 1 CRR-NY 142.3 prior to the start of Work.

B. Reference Standards

1. Federal regulations, 7 CFR 301.51- Asian Longhorned Beetle

2. NYCRR Title 1 Part 139 – Control of the Asian Long Horned Beetle

3. NYCRR Title 1 Part 142 – Exterior Quarantine of Spotted Lanternfly

4. NYCRR Title 6 Part 575 – Prohibited and Regulated Invasive Species

5. American National Standards Institute A300 and Z133.1 – Standards for Tree Care and Arboricultural Operations.

1.05 DESCRIPTION

A. Project/Site Conditions

1. Streets, roads, adjacent property and other works and structures shall be protected throughout the entire Project. Contractor shall return to original

condition, satisfactory to the Engineer, facilities damaged by the Contractor's operations.

2. If the project site is in an Asian Longhorned Beetle Quarantine Zone, USDA APHIS and/or NYCRR Title 1 Part 139.4 prohibits the movement of regulated articles from the quarantine zone without an ALB Compliance Agreement.

3. New York State has enacted an external quarantine covering areas of states where SLF is known to have populations. SLF restriction info can be found online from NYS Department of Agriculture and Markets.

   a. More information is available at the following link: https://agriculture.ny.gov/spottedlanternfly

1.06 QUALITY ASSURANCE

A. Codes and Standards: State and local laws and code requirements shall govern the hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris and other matter.

B. The Contractor or subcontractor responsible for Work of any kind affecting ALB Regulated Articles within the Asian Longhorned Beetle Quarantine Zone must have an ALB Compliance Agreement. Work includes, but is not limited to planting trees, transplanting trees, pruning trees, fertilizing trees, removing trees and stumps, and Clearing and Grubbing trees or roots.

C. Spotted Lanternfly Restrictions on Movement of Regulated Articles

1. Regulated Articles originating from a quarantine area shall not be moved into the Project Site unless the Regulated Article is:

   a. Accompanied by a certificate of inspection,

   b. Loaded, handled, or shipped in a manner reasonably designed to prevent it from becoming infested with or harboring spotted lanternfly; and accompanied by a waybill that sets forth its point of origin and intended destination.

   c. Accompanied by a waybill that sets forth its point of origin and intended destination.

2. Regulated Articles that do not originate from a quarantine area but have moved through a quarantine area shall not be moved into the Project Site unless the Regulated Article is:

   a. Accompanied by a waybill that sets forth its point of origin and intended destination; and

   b. Moved directly through a quarantine area without stopping except for refueling and traffic conditions.

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval by the Engineer. Shop Drawings shall identify all trees designated for removal and those that shall remain and require protection, as directed by the Engineer.

B. Tree Protection Plan

1. The Contractor shall submit a Tree Protection Plan to the Engineer for approval prior to performing any Work on trees or shrubs to be saved or in the vicinity of such trees and shrubs. The Plan must be approved prior to any such Work being performed.

a. The Plan shall be prepared in consultation with the Engineer.

1) The Plan should include, but not necessarily be limited to, the location of temporary wooden tree guards, construction fence, temporary snow fence boundary, range fencing, micro tunneling, soil erosion and sediment control, hand and/or pneumatic excavation, soil compaction prevention and mitigation requirements, impact of trenching and/or cut and fill operations and pruning and fertilization schedule. Soil testing and fertilization schedule, as well as other applicable methods of tree protection shall be as required by Sections 32 90 00 - Planting and 32 90 05 – Soil Mixes.

2) In addition, the Plan should address the Contractor's operations, including designated staging areas, Site access and stockpiling of materials.

3) Mandatory provisions of the Plan always include, but are not limited to, the following provisions:

a) The Contractor shall not be permitted to park vehicles or equipment or to stockpile materials of any nature under the drip line of trees and shrubs in order to minimize surface and subsurface root damage and soil compaction. This directive shall apply to all areas within or outside the contract limit line.

C. Asian Longhorned Beetle Management Plan

1. The Contractor responsible for site clearing and grubbing shall submit an ALB Management Plan to the Engineer for approval prior to removal of any trees or vegetation from the construction Site. The Plan shall identify each Work Site and all transportation routes, haulers, processing and disposal facilities including full contact information. The Plan shall confirm whether any debris will be generated, transported, processed or disposed in an ALB Quarantine Zone. If the construction site, transportation routes, processing and disposal facilities are not within an ALB Quarantine Zone, no further details are required in the Plan.

2. If ALB Regulated Articles are generated at a site that is not located within an ALB Quarantine Zone, but the materials will be transported into or through a quarantine zone for processing or disposal, the Plan shall also include:

    a. For Interstate Movement - A copy of the ALB Limited Permit authorizing such movement or specific procedures for ensuring compliance with 7 CFR 301.51-4 which regulates the movement of Regulated Articles.

    b. For Intrastate Movement - Identification of the origin and destination of the regulated article in accordance with NYCRR Title 1 Part 139.

    c. A copy of the processing or disposal facility's ALB Compliance Agreement.

3. If the Site is located within an ALB Quarantine Zone, the Plan shall also include the following:

    a. A copy of the Contractor's ALB Compliance Agreement with USDA APHIS.

    b. A description of the survey methods to identify any ALB infestation and ALB Regulated Articles. The survey shall be performed by a professional in possession of an ALB Compliance Agreement, and shall be performed prior to felling trees and removing any ALB Regulated Articles from the Site. Evidence of the professional's ALB Compliance Agreement shall be provided in the Plan. The results of the survey shall be summarized in an ALB survey report and provided to the Engineer prior to removing any ALB Regulated Articles from the Site.

    c. Provisions for notifying the Engineer and a USDA APHIS inspector immediately upon the discovery of an ALB infestation. If an ALB infestation is discovered, the Contractor shall stop all site Clearing and Grubbing until permission to resume Work has been given in writing by a USDA APHIS Inspector. A copy of the permission to resume Work shall be provided to the Engineer.

4. Unless the survey report specifically confirms the absence of Regulated Articles, the Plan shall also include the following:

    a. Schedule for conducting activities affected by ALB Regulated Articles

    b. Identification and anticipated quantity of ALB Regulated Articles and proposed handling methods.

        1) If the ALB Regulated Articles are destined for a processing facility, the facility shall be in possession of an ALB Compliance Agreement. The Plan shall include a copy of the

facility's ALB Compliance Agreement for handling Regulated Articles.

2) If the ALB Regulated Articles are to be transported out of the ALB Quarantine Zone, a copy of the Contractor's ALB Compliance Agreement for transporting Regulated Articles out of an ALB Quarantine Zone shall be included in the Plan.

c. Storage location for ALB Regulated Articles

d. Treatment methods if the Contractor elects to treat ALB Regulated Articles onsite such that they are no longer regulated. On-Site treatment requires that the responsible party be in possession of an ALB Compliance Agreement and requires coordination with USDA APHIS or a professional in possession of an ALB Compliance Agreement with USDA APHIS for inspection and verification. A copy of the responsible party's ALB Compliance Agreement shall be provided in the Plan.

e. Protocol for tracking the shipment of ALB Regulated Articles using a bill of lading or manifest that identifies the Site, transporter, truck identification number and provides for signature upon receipt at the processing or disposal facility. Payment of the removal of ALB Regulated Articles will not be made until signed copies of the bill of lading or manifest are provided to the Engineer.

D. ALB Survey Report

1. The Contractor responsible for site clearing and grubbing within an ALB Quarantine Zone is required to have the site surveyed for the presence of ALB by a professional in possession of an ALB Compliance Agreement. The Contractor shall submit an ALB Survey Report to the Engineer within two weeks of survey completion. Regulated Articles may not be moved offsite without Engineer approval of the ALB Survey Report. The ALB Survey Report shall be signed by the professional and shall include a copy of the surveyor's ALB Compliance Agreement.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall guarantee that work performed under this Section will not permanently damage trees, shrubs, turf or plants designated to remain, or other adjacent work or facilities. If damage resulting from Contractor's operations appears during the period up to 12 months after completion of the Project, the damaged items shall be replaced as directed by DEP at no expense to DEP, to the satisfaction of the DEP.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Tree Protection Barriers

1. Protective barriers shall be made of 3/8-inch-thick plywood or other rigid material acceptable to the Engineer and DEP.
2. Barriers shall be adequately framed and anchored to the ground to withstand impacts from equipment.
3. Barriers shall be at least 4 feet tall and 4 feet wide, or wide enough to completely shield the area to be protected from equipment entry.
4. Barriers shall be placed on the operational side(s) of trees to remain, and trees shall be centered behind them. Barriers shall be located as far from trees as possible, but in no case shall be located less than 4 feet away from the trunks of trees to remain.
5. Orange construction fencing is not an acceptable barrier unless otherwise approved by the Engineer.
6. Barriers shall be installed around all trees to remain, including those adjacent to storage, staging, stockpiling and lay down areas.
7. Barriers shall be inspected on a regular basis and repaired as necessary for the duration of the Work.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Trees and Shrubs to be Saved

1. Protection: The Contractor shall protect from defacement, injury and destruction all trees and shrubs within the construction site that are so delineated or are marked in the field to be saved. Trees, shrubs and grassed areas which are to remain shall be protected by fences, barricades, wrapping or other methods as shown on the Contract Drawings, specified or approved by the Engineer.

a. Within the limits of the area from the tree trunk up to 3 to 4 feet outside of the tree drip line, Work shall be performed with extreme care using either hand tools or equipment that will not cause damage to trees.

   1) Do not disturb or cut roots unnecessarily. Do not cut roots 2 inches or larger unless approved.

   2) Immediately backfill around tree roots after completion of construction in the vicinity of trees.

   3) Do not operate any wheeled or tracked equipment within drip line.

b. Vegetation shall be protected from damage caused by emissions from engine-powered equipment.

c. During working operations, the trunk, foliage and root system of all trees to be saved shall be protected with boards or other guards placed as shown on the Contract Drawings and as required to prevent damage, injury and defacement.

   1) Excavated materials shall not be piled within the drip line or adjacent to the trunks of trees. Equipment, stockpiles, etc. shall not be permitted within the drip line.

   2) Do not allow runoff to accumulate around trunks of trees.

   3) Ropes, cables, or guy wires shall not be fastened or attached to trees without permission. When such permission is granted, protect the tree before making fastening or attachments by providing burlap wrapping and softwood cleats.

   4) The use of axes or climbing spurs for trimming will not be permitted.

   5) Provide climbing ropes during trimming.

d. When directed by the Engineer, shrubs to be saved shall be removed by taking a sufficient earth ball with the roots to maintain the shrub.

   1) Temporarily replant, if required, and replace at the completion of construction in a condition equaling that which existed prior to removal.

   2) Replace in kind if the transplant fails. Provide transplanting, planting, and watering and guarantee as specified in Section 32 90 00 – Planting.

e. When directed by the Engineer, emergency repair to damaged trees and to trees that pose imminent danger shall be performed within 24 hours.

f. Damage Assessment

1) Tree damage. For trees that are damaged during the course of construction, a monetary credit shall be taken. The monetary assessment shall be the difference between the tree's condition rating, as per the International Society of Arboriculture appraisal method, before and after the damage. The damage assessment shall be determined by the Engineer.

2) Tree Destruction. Any trees irreparably damaged during the course of construction, as determined by the Engineer shall be removed at the Contractor's sole expense. Restitution shall be made according to the Caliper Area Replacement formula, as determined by the Engineer. Restitution can be met by the Contractor through the following options:

a) Direct planting by the Contractor or its subcontractor of the required equivalent number of replacement trees at locations determined by the Engineer; or

b) A monetary credit for the value of the tree destroyed; or

c) A combination of (1) and (2) above, as determined by the Engineer. If the Contractor plants replacement trees, a monetary credit shall be taken for the difference between the full value of the destroyed tree and the value of the number of replacement trees planted.

3) Tree Removal. Restitution for any prohibited tree removals shall be made according to the Caliper Area Replacement formula, with adjustments for tree condition as per the International Society of Arboriculture appraisal method, as determined by the Engineer.

B. Air pollution caused by dust and dirt shall be controlled, complying with governing regulations. Dust control shall be as specified in Section 31 25 10 – Dust, Soil Erosion and Sediment Control.

C. Stripping Topsoil

1. The Contractor shall strip existing topsoil as described in Section 31 23 16 – Excavation. Heavy growths of grass shall be removed from areas before stripping the topsoil.

3.02 IMPLEMENTATION

A. Removal of Trees and Shrubs

1. Tree Removal within Property Limits:

a. Only those trees designated on the Contract Drawings for removal shall be removed.

b. Tree and shrub removal shall be conducted in a manner so as to avoid damage to those trees and shrubs which will remain.

c. Do not cut or damage trees or shrubs outside of the Contract limit lines. Damage outside the Contract limit lines caused by the Contractor's operations shall be corrected at the Contractor's expense.

d. All trees shall be calipered at four and one-half feet above existing grade prior to removal. All trees shall be "topped" and "limbed" previous to felling unless otherwise directed by the Engineer.

e. In areas of major construction, the stumps and roots of all trees designated for removal shall be grubbed and excavated to a depth of three (3) feet below the ground surface except in areas of fill greater than three (3) feet, where such trees may be cut flush with the ground surface.

B. Asian Longhorned Beetle Quarantine Zone

1. The Asian Longhorned Beetle (ALB) is a destructive wood boring insect. It can cause serious damage to healthy trees by boring into their heartwood and eventually killing them. Nursery stock, logs, green lumber, firewood, stumps, roots, branches and debris of one-half (½") inch or more in diameter are subject to infestation. In an effort to control the spread of the beetle to other areas, a quarantine has been imposed by USDA APHIS on large portions of the City of New York as per Part 139 of Title 1 NYCRR.

2. Any Contractor or subcontractor performing tree work of any kind within the ALB Quarantine Zone must have an ALB Compliance Agreement and will be held responsible for compliance with USDA APHIS. Tree work includes, but is not limited to planting trees, transplanting trees, pruning and fertilizing trees, removing trees and stumps, and Clearing and Grubbing trees or roots.

a. A current map of the geographic area included in the ALB Quarantine Zone within New York City is available at the following website: https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/asian-longhorned-beetle/ct_alb_maps

b. Additional information is available at the following website: http://www.dec.ny.gov/animals/7255.html

C. Clearing and Grubbing

1. Clearing: The Contractor shall clear all items specified to the Contract limit lines shown on the Contract Drawings and shall remove cleared and grubbed materials from the site to an authorized disposal Site.
    a. Do not start earthwork operations in areas where Clearing and Grubbing is not complete, except that stumps and large roots may be removed concurrent with excavation.
    b. Comply with erosion, sediment control and storm management measures as specified in Section 31 25 10 - Dust, Soil Erosion and Sediment Control.
2. Grubbing: The Contractor shall Clear and Grub areas to be excavated, areas receiving less than 3 feet of fill and areas upon which structures are to be constructed.
    a. Stumps and root mats in these areas shall be removed to a depth of not less than 1 foot below the subgrade of sloped surfaces.
    b. All depressions made by the removal of stumps or roots shall be filled with material suitable for backfill as specified in Section 31 23 23 - Fill.
3. Limited Clearing: The Contractor shall clear areas receiving more than 3 feet of fill by cutting trees and shrubs as close as practical to the existing ground. Grubbing will not be required.
4. Disposal:
    a. All disposals off-site shall be in complete accordance with rules and regulations of the authorities having jurisdiction.
    b. Burning of cleared and grubbed materials is not allowed within the property limits.
5. Explosives shall not be used.
6. No cleared or grubbed material may be used in backfills or structural embankments.
7. Cleared and grubbed items shall be removed from the site and disposed of in accordance with the applicable regulations and requirements of this Contract.

3.03 FIELD TESTING / QUALITY CONTROL

A. Certified Arborist

1. All tree protection, pruning, tree repair, and tree removal is to be performed by competent workers only, under the supervision of an arborist holding certification from the International Society of Arboriculture (ISA), or registered with the American Society of Consulting Arborists or equivalent education and experience. The Contractor shall hire an ISA certified arborist to oversee all tree work near trees associated with this Project,

including, but not limited to excavation, shoring, and utility/pavement installation.

B. Protective Barriers

1. Barriers shall be inspected on a regular basis and repaired as necessary for the duration of the Work. At completion of the Work, and upon approval of the Engineer, the Contractor shall remove and properly dispose of barriers.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes excavation Work and reuse or disposal of all material as specified herein, shown on the Contract Drawings or required by the Engineer, for any purpose pertinent to the construction of the Work.

B. Excavation Work includes stripping and stockpiling of topsoil; sheeting and bracing; excavation over the Site; excavation for roads, pipelines and structures; removal and control of water in and around excavations; segregation and stockpiling of excavated material; disposal of unsuitable material and excess excavated material; reuse of suitable material; and trimming, shaping and grading of excavations.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	5
1.06	Quality Assurance	6
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	9
1.09	Spare Parts, Special Tools, and Supplies	9
1.10	Warranty	10
PART 2	PRODUCTS	10
2.01	Manufacturers	10
2.02	Materials / Equipment	10
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Implementation	14
3.03	Field Testing / Quality Control	16
3.04	Startup / Demonstration	17
3.05	Adjusting / Protection / Cleanup	17

D. The following attachments, attached after the End of Section designation, are a part of this Section:

1. Attachment A, Minimum Load Diagram for Non-Water Tight Sheet Sheeting Design During Excavation (refer to Article 1.05)

2. Attachment B, Minimum Load Diagram for Water Tight Sheeting Design During Excavation (refer to Article 1.05).

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 35 45 - Hazardous Materials Control

B. Section 02 24 20 - Soil Sampling and Analysis

C. Section 05 12 00 - Structural Steel Framing

D. Section 31 10 10 - Site Clearing

E. Section 31 23 19 - Dewatering

F. Section 31 23 23 - Fill

G. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

H. Section 31 40 00 - Shoring and Underpinning

I. Section 32 90 05 - Soil Mixes

1.04 REFERENCES

A. Definitions:

1. Case-Specific Beneficial Use Determination (BUD): Under 6 NYCRR Part 360, Section 360.12(d), NYSDEC sets forth the requirements for petitioning NYSDEC to obtain a Case-Specific BUD, and the criteria for reviewing, granting, or denying of the BUD. For reuse of a solid waste to be determined a beneficial use, the petition must satisfy all criteria outlined under 6 NYCRR Part 360, Section 360.12(d).

2. Excavated Material: All material regardless of its nature, except rock or boulders that have been excavated.

3. Fill: Soil and similar material excavated or brought to the Project Site for the purposes of construction. All fill material must meet the requirements of Section 31 23 23 – Fill. Material to be excavated and proposed for reuse as fill under Pre-Determined Beneficial Use must meet the requirements of 6 NYCRR Part 360, Section 360.13 (a), Applicability, Section 360.13 (b), Waste Cessation, or Section 360.12(c)(1)(iv)(a), Material ceases to be waste when used as backfill in the same excavation or for grade adjustment on the site of generation. If these criteria cannot be met, such material shall meet Section 360.12(d), Case-specific beneficial use determinations - general. Fill that is imported from another DEP Project Site must specifically meet Fill Type 2 maximum concentration levels. Fill from any other off-site

source shall be non-hazardous, uncontaminated, and shall also meet Fill Type 2 maximum concentration levels.

4. New York City Metropolitan Area Waste Impact Zone: The area encompassing the City of New York and the counties of Nassau, Suffolk, Putnam and Westchester, as per 6 NYCRR Part 360.2 Definitions.

5. Pre-Determined Beneficial Use for fill material: Under 6 NYCRR Part 360, Section 360.13(b) Waste cessation. "Excavated material ceases to be solid waste in accordance with the following:

   a. Fill Type 1 generated outside of the New York City Metropolitan Area Waste Impact Zone (NYCMAWIZ) – once a determination has been made that the material is Fill Type 1;

   b. Fill Type 1 generated within Nassau, Suffolk, Westchester and Putnam Counties – once the material is delivered to the site of reuse;

   c. Fill Type 1 cannot be generated within the City of New York;

   d. Fill Type 2 and Fill Type 3 generated outside of the NYCMAWIZ – once a determination has been made that the material is Fill Type 2 or Fill Type 3;

   e. Fill Type 2 and Fill Type 3 generated within the NYCMAWIZ – once the material is delivered to the site of reuse;

   f. Fill Type 4 and Fill Type 5 – Once the material is delivered to the site of reuse."

   g. Under 6 NYCRR Part 360, Section 360.12(c)(1)(iv)(a), "Excavated material used to backfill the same excavation or as grade adjustment in areas of similar physical characteristics on the site of generation. If the material exhibits visual or historical evidence of contamination (including odors) and will be used in an area with public access, the material must be covered with pavement, foundation, or with a minimum of 12 inches of soil or fill that meets the criteria to be used as Fill Type 1 and Fill Type 2" as defined in Subdivision 360.13, Special requirements for pre-determined beneficial use of excavated material. Refer to Section 02 24 20 - Soil Sampling and Analysis for sampling requirements, including a list of parameters to be analyzed for soils to be reused on-site, or soils to be reused or disposed off-site.

   h. As per 6 NYCRR Part 360, Section 360.13.(c), Notification requirements in the City of New York. For fill types 2 through 5, NYSDEC shall be notified at least five (5) days before the first load greater than ten (10) cubic yards is planned to be transported from the site of excavation directly to a site of reuse within New York State. Notifications shall be made on forms acceptable to NYSDEC and shall include all associated analytical data reports.

i. Notification of fill placement. For Fill Types 4 and 5 generated outside the City of New York, NYSDEC shall be notified at least five days before the first load greater than ten (10) cubic yards is planned to be transported directly from the site of excavation to the site of reuse within New York State. Notifications shall be made on forms acceptable to NYSDEC and shall include all associated analytical data reports.

6. Suitable Material: Any material whose composition is satisfactory for use as fill. Any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man-made (i.e. recycled) origin, including mixtures thereof, are considered suitable materials. Determinations of whether a specific natural material is suitable shall be made by the Engineer on the above basis.

7. Topsoil: Topsoil shall consist of natural loam, free from subsoil, obtained from an area which has never been stripped. Topsoil is friable clay loam surface soil found in a depth of not less than 4 inches, and is substantially free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material. Topsoil shall be as further defined under Section 32 90 05 – Soil Mixes. Topsoil meeting this definition and Section 32 90 05 – Soil Mixes shall be considered suitable for use on-site.

8. Unsuitable Materials: Any material containing vegetable or organic matter such as muck, peat, organic silt, topsoil or sod, that is not satisfactory for the use as fill material.

B. Reference Standards:

1. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

2. Occupational Safety and Health Administration (OSHA); OSHA 1926 Subpart P-Excavations

3. U.S. Department of Labor (DOL)

4. Industrial Board of Appeals, N.Y.S. Department of Labor, Part 23 Protection in Construction, Demolition and Excavation Operations latest editions

5. New York City Rules and Regulations (RCNY)

6. New York State Department of Transportation (NYSDOT)

7. New York City Department of Transportation (NYCDOT)

8. New York State Department of Environmental Conservation (NYSDEC)

9. U.S. Department of Transportation, Federal Highway Administration

10. U.S. Environmental Protection Agency (EPA)

11. NYSDEC regulations, 6 NYCRR Part 375, Environmental Remediation Programs

12. NYSDEC regulations, 6 NYCRR Part 360, Solid Waste Management Facilities General Requirements

13. New York City Building Code

1.05 DESCRIPTION

A. Design Requirements:

1. In designing the sheeting, take note of the minimum load diagram requirements of the DEP, shown in Attachments A and B (located after the "End of Section" designation), unless otherwise shown on the Contract Drawings. However, when it is anticipated that heavier crane or equipment loads will fall within the influence line of the excavation, increase design loads accordingly.

2. The Contractor's operations shall conform to the requirements of Section 31 25 10 - Dust, Soil Erosion and Sediment Control.

3. Site Conditions:

a. Actual Conditions: Perform any geotechnical investigations deemed necessary to determine actual Site conditions. Geotechnical data reports, if they are available, will be provided in the Contract Documents.

b. Underground Utilities: Locate and identify all existing underground utilities prior to the commencement of Work.

B. Regulatory Requirements:

1. General: Before proceeding with any excavation, obtain all necessary permits required by agencies having jurisdiction and consents from owners of private property where their interests may be affected by the Work, such as for temporary or permanent occupation, for disposal or storage of materials, or other encroachment except where temporary easements may have been obtained by the DEP in connection with permanent easements or otherwise.

2. Excavation operations and related Work shall be performed in strict compliance with the applicable sections of OSHA 1926 Subpart P-Excavations, New York City Department of Buildings Regulations and N.Y.S. Department of Labor, Industrial Board of Appeals, Part 23 Protection in Construction, Demolition and Excavation Operations latest editions.

3. In the period of 2 to 10 days prior to starting excavation, notify all utilities of intended Work locations and have utility locations marked. In NYC locations, the New York City Long Island One Call Center (800-272-4480) is available for this use.

4. Recycled materials that the Engineer has evaluated and approved for general use shall be considered to be Suitable Material subject to the conditions for use as determined by the DEP. In general, the use of recycled materials must be sanctioned by NYSDEC, usually in the form of a BUD. See definition above.

C. Excess soils not reused onsite shall be reused offsite to the extent possible in the following hierarchal locations:

1. Other DEP projects that need available, excess suitable materials;
2. The NYC Clean Soil Bank managed by the Mayor's Office of Environmental Remediation (OER);
3. New York State beneficial use facilities;
4. Or outside of New York State at other applicable out-of-state agency beneficial use facilities.

1.06 QUALITY ASSURANCE

A. Certification of Laboratory Services:

1. For certification of Laboratory Services see Section 02 24 20 - Soil Sampling and Analysis.

1.07 SUBMITTALS

A. Sheeting and Bracing: Before commencing any excavating operations, submit for approval Shop Drawings of all sheeting and bracing, cofferdams, bridging, decking, soldier beams and lagging, and other temporary or permanent supporting structures. Shoring and underpinning submittals shall be as required by Section 31 40 00 – Shoring and Underpinning.

1. Shop Drawings shall show types of materials, dimensions and details of the entire bracing system, including wale splices and corner connections, stressing/jacking methods, reaction systems, posting and rebracing, if necessary.
2. Provide plans, details and procedures for jacking-in preload at struts.
3. For sheeting and shoring not shown on the Contract Drawings submit engineering calculations and design assumptions for determination of loads and stresses acting in the wall and lateral supports during installation, as well as final conditions. Show locations at which the temporary or permanent supporting structures will be used. The proposed design shall take into account the excavation procedures, dewatering operations, surcharge loading, soil properties, material stresses, temperatures, permanent construction, stages of work and all other conditions which could affect the excavation support system and the permanent structure. These drawings and calculations shall be prepared and stamped by a Professional Engineer licensed in the State of New York.

B. Soil Excavation, Reuse, Transport and Disposal Plan (SERTD Plan): Submit a SERTD Plan to the Engineer for approval at least 30 calendar days prior to the start of excavation. The SERTD Plan shall include two protocols: the Excavation Protocol and the Reuse, Transport and Disposal Protocol.

1. The Excavation Protocol shall include, but not be limited to, the following:
    a. Limits of excavation
    b. Excavation methods
    c. Protection methods:
        1) Sheeting and bracing
        2) Fencing, bridging and decking
2. The Reuse, Transport and Disposal Protocol shall address the following waste classifications defined in Section 02 24 20 – Soil Sampling and Analysis: hazardous solid waste; non-hazardous contaminated waste; non-hazardous petroleum-contaminated waste; non-regulated solid waste, and construction and demolition (C&D) debris. The Protocol shall include the following:
    a. Details on proposed reuse:
        1) Identities of beneficial use facility (ies) with copy (ies) of their regulatory approvals, as applicable. Unless otherwise reused under Pre-Determined Beneficial Use, details shall include all supporting back-up information sent to and received from NYSDEC or other applicable out-of-state agency. See Section 02 24 20 - Soil Sampling and Analysis for on-site reuse criteria. When reusing soils on site, details of temporary (stockpile) storage and the location(s) of reuse shall be identified.
        2) As applicable, the requirements of each beneficial use facility / treatment, storage, and disposal facility (TSDF) for sampling, including analytical parameters, frequencies, protocols, and minimum detection limits.
    b. Transportation details:
        1) Identities of waste transporters; supporting NYSDEC Part 364 Waste Transporter Permit(s) and other out-of-state transporter permits required to transport the wastes to the TSDFs; or for use of public roadways if temporary off-Site storage becomes necessary.
    c. Disposal details:
        1) Identities of TSDFs solicited including names and locations, insurance certificate, permit documentation including the types of materials allowed and not allowed, and chemical

and physical material acceptance criteria. If no concentrations are indicated, then the facility must indicate the types of material that it is allowed to accept under its permit. Treatment, storage, or disposal of any waste generated by excavation Work shall be at a facility permitted to accept such waste by an authorized state or local government agency, or the EPA, as applicable.

3. The SERTD Plan shall be coordinated with the Field Sampling Plan (FSP), including beneficial use facilities/TSDF selection, and associated materials acceptance requirements specified in Section 02 24 20 – Soil Sampling and Analysis, as applicable.

4. The SERTD Plan shall be prepared in accordance with all applicable Federal, State and local hauling and disposal codes and regulations

5. Reuse of excavation spoils either on-site or off-site must be prioritized over disposal. TSDFs shall only be approved where reuse options are not available.

6. Under separate cover, additional waste disposal documentation submittals for DEP signature as generator. The Contractor shall provide waste profiles, facility letters of acceptance of DEP waste, advance copies of waste manifest(s), and Land Disposal Restriction (LDR) Notification and Certification Form (if hazardous waste) for the Engineer's review and approval and DEP signature as generator, where applicable.

C. Manifest Requirements and Submittals: Manifests shall include measurements of the volume of all excavated material to be removed from the Site prior to transporting to an approved beneficial use facility/ TSDF. The Contractor shall also prepare all vehicles and manifests necessary for transporting all material. The Contractor shall comply with all Federal, State and local regulations regarding the transport of hazardous and non-hazardous waste.

1. Applicable Regulations: All Contract Work that concerns the transport of hazardous and non-hazardous waste shall comply with the appropriate EPA and NYSDEC regulations, and DOT hazardous material transportation regulations.

2. EPA Hazardous Waste Manifest: The Contractor shall obtain an appropriate number of hazardous waste manifest forms (EPA Form 8700-22 (Rev. 3-05) or latest version), sequentially numbered for this Contract based on the quantity of hazardous waste to be removed from site. The name of the generator, transporter and TSDF, and their appropriate EPA identification number, shall be typed on each form. All other pertinent information shall be included on the manifest. A copy of the partially completed manifest including the above information shall be submitted for approval at least 3 weeks prior to commencement of excavation.

a. Routing: The Contractor shall provide a map and written description of the route which will be taken to the approved TSDF by the hazardous waste transporter.

3. Non-hazardous Waste Manifest: Manifests shall be provided for each truckload of non-hazardous waste removed from the Site, including soils destined for reuse. The form of the manifest shall be approved by the Engineer. Non-hazardous waste shall be transported in accordance with all applicable local, State and Federal DOT regulations by properly licensed and permitted waste haulers.

   a. Routing: The Contractor shall provide a map and written description of the route which will be taken to the approved beneficial use facility / TSDF by the non-hazardous waste transporter.

4. The Contractor shall submit written evidence that selected beneficial use facilities / TSDFs have accepted or will accept the materials generated during excavation. The Contractor shall also submit copies of the completed manifest, signed and dated by the initial transporter, in accordance with Federal and State requirements and with associated documentation (e.g., waste profile and Hazardous Waste LDR Notification and Certification Form, as applicable). Copies of completed and signed waste manifests from beneficial use facilities / TSDFs shall be provided to the Engineer within 30 days of waste shipment off-Site.

5. Bill of Lading: Bills of Lading shall be provided for all uncontaminated soils destined for reuse off-site. Uncontaminated soil shall be removed by a properly licensed hauler.

6. Notification to the NYSDEC must be made prior to the first load greater than 10 cubic yards is planned to be transported from the Site of excavation directly to the Site of reuse.

   a. At least five days in advance of transfers of Fill Types 2, 3, 4 and 5 generated in, imported to, or relocated within the City of New York.

   b. At least five days in advance of transfers of Fill Type 4 and Fill Type 5 anywhere in the State of New York.

7. The Notification of Fill Transfer for Reuse form (NYSDEC Division of Materials Management, version 03/24 or latest) will be sent to the NYSDEC Regional Office in which the destination is located. The form must be certified by a Qualified Environmental Professional (QEP). In the event the QEP is not a Professional Engineer or Geologist licensed in New York State, the QEP's basis for credential must be attached to the form.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Steel for struts, braces, and whalers shall meet the requirements of Section 05 12 00 – Structural Steel and the Contract Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. General: No excavation Work below the water table shall begin before the Dewatering Plan is approved, as specified in Section 31 23 19 - Dewatering.

B. Clearing and Grubbing: Clear and grub the site of all open cut excavations and all areas shown on the Contract Drawings and specified. The Contractor shall comply with the requirements of Section 31 10 10 - Site Clearing.

C. Stripping: Completely strip all topsoil and earth containing roots away from areas which have been cleared and grubbed. Topsoil which is determined by the Engineer to be suitable for future reuse by DEP shall be stripped separately and stockpiled at locations on the Site as directed by the Engineer. Topsoil to be reused on-site shall comply with the requirements of Section 32 90 05 – Soil Mixes. Topsoil to be reused on-site or off-site may require testing to meet the requirements for NYSDEC Pre-Determined Beneficial Use or a Case-Specific BUD per 6 NYCRR Part 360, or other applicable out-of-state agency's requirements for a Case-Specific BUD. For further discussion on topsoil reuse refer to Section 02 24 20 – Soil Sampling and Analysis and Section 31 23 23 – Fill.

D. Sheeting and Bracing:

1. The Contractor shall provide all labor, equipment, materials and incidental items and services necessary to perform sheeting and bracing as indicated on the Contract Drawings and specified herein. Sheeting and bracing shall include but not limited to:

a. Furnish, install, preload and maintain a system of wales, struts, kickers and bracing appurtenances to shore portions of the earth support walls as shown on the Contract Drawings.

b. After support is provided, including installation of base slabs, unload and remove wales, struts, kickers and bracing as required.

c. The arrangement, construction, testing and maintenance of the lateral bracing system shall be the responsibility of the Contractor.

2. All excavations shall be excavated with vertical sides and properly sheeted and braced for the full depth of the excavations, unless otherwise shown on the Contract Drawings, specified or ordered in writing by the Engineer. All excavation shall be shored and braced in accordance with 29 CFR 1926 Subsection P requirements and New York City Department of Buildings regulations

3. Pilot cuts for excavations shall not exceed 5 feet in depth and shall be made with equipment approved by the Engineer. The equipment to be used and the method to be employed in starting the sheeting operation shall be submitted for approval and must be approved in writing by the Engineer before the start of Work.

4. Exception: Excavation for structures or pipe lines 5 feet in depth or less need not be sheeted and braced except where excavation is in close proximity to existing footings or conduits and where unsupported sides may be unstable.

5. Design and install sheeting and bracing in excavations for pipe lines so that at no time shall sheeting be braced or blocked against the sides of pipe or conduit. Do not drive sheeting for pipelines below the elevation of the bottom of the pipe. If it is necessary to drive the sheeting below that elevation in order to obtain a dry trench or satisfactory working conditions, cut off the sheeting and leave in place below the top of the pipe at no additional cost to DEP.

a. Contractor shall design and provide additional and supplemental sheeting and bracing as needed to perform the excavation.

b. Adjust field locations of wales, rakers, struts and braces as required and approved by the Engineer to avoid interference with new Work and provide sufficient bearing. Block between wales and sheets with steel shims immediately after installing braces.

c. Struts shall be wedged, posted and tied to form a stiff support. Rakers and struts to be preloaded shall be jacked to the loads shown on the Contract Drawings. Rakers and struts shall be preloaded in the presence of the Engineer.

d. Provide web stiffeners, plates or angles as needed to prevent rotation, crimping or buckling of connections and points of bearing

between structural steel members and/or jacks occasioned by eccentricities caused by field fabrication, assembly or conditions.

e. Protect bracing members from damage by construction equipment and other causes. Repair any damage promptly and erect temporary barriers to secure area of damage, as required.

6. Where permitted or ordered in writing by the Engineer, slope the sides of the excavation to elevations approved by the Engineer and excavate below such elevations with vertical sides, properly sheeted and braced. Side slopes must be stable. Banks more than 5 feet high shall be shored and sloped to the angle of repose in accordance with current OSHA standards to furnish safe working conditions, to prevent shifting of material, to prevent damage to structures or other work and to avoid delay to the Work, all in compliance with U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 and under Contract Work Hours and Safety Standards Act, as amended. The minimum shoring, sheeting and bracing for trench excavations shall meet the general trenching requirements of the applicable safety and health regulations. However, in no case shall the sides of trench excavations for pipe or conduit be sloped to elevations lower than 2 feet above the top of the pipe or conduit.

7. Removal of sheeting:

a. When the sheeting and bracing for the vertical sides of such trench excavations is not required to be left in place, such sheeting and bracing shall be removed, and backfill shall be placed and compacted to an elevation at least 1'-6" above the top of the pipe or conduit. This requirement shall be met unless an exception is provided elsewhere in the Contract Documents.

b. Where sheeting and bracing is removed, it shall be done as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures, except as otherwise shown on the Contract Drawings or directed. Carefully fill voids left by the withdrawal of the sheeting by ramming or otherwise as directed by the Engineer.

c. Obtain permission of the Engineer before the removal of any shoring, sheeting or bracing. Such permission by the Engineer shall not relieve the Contractor of responsibility for injury to structures or to other property or persons resulting from failure to leave such sheeting and bracing in place.

d. Load from rakers, struts and corner braces shall be released in a controlled fashion by cutting kickers and removing wedges and shims, as approved by the Engineer.

8. Credit: Sheeting and bracing required to be provided by the Contract Drawings or the Sections and subsequently allowed or ordered in writing

by the Engineer to be omitted shall be subject to suitable credit to the DEP. Measurement of sheeting and bracing limits subject to suitable credit shall extend from the subgrade to within 18 inches of the ground surface in the case of vertical sides, regardless of stages; and shall extend from the subgrade to 12 inches above the junction of the vertical and sloping sides in the case of excavations with sloped sides above and vertical sides below. Sheeting and bracing indicated to be omitted on the Contract Drawings will not be subject to credit.

9. Width: The width of trenches, between inner faces of sheeting or rock, as the case may be, shall not exceed the width of the structure to be installed by more than 3 feet. Where two or more stages of sheeting are used, the width of trench shall not exceed the width of structure by 3 feet at the lowest stage of sheeting to a point 2 feet above the top of pipe or conduit.

10. In cases where sheeting and bracing will not adequately protect adjacent structures from damage and settlement, the Contractor shall employ other methods, such as underpinning. The Contractor shall hold the DEP harmless from all claims for damage arising from failure to adequately protect all structures. The Contractor will be presumed to have fully examined and inspected the buildings before estimating the costs and hazards involved.

11. If, in the opinion of the Engineer, any of the approved temporary or permanent supporting structures are inadequate or unsuitable for the actual conditions in the field, the Engineer may direct the Contractor to strengthen the supporting structures at no additional cost to DEP. The Contractor shall be responsible for the sufficiency of all temporary and permanent supporting structures whether or not directed by the Engineer to strengthen them.

E. Protection of Plants and Structures: Before starting excavation, clear away all obstructions which are to be removed or relocated. Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Comply with the requirements of Section 31 10 10 - Site Clearing.

F. Frost Prevention: Protection shall be provided against the penetration of frost into material below the bearing level during work in the winter months. This protection shall consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other approved means.

G. Removal of Water:

1. Conform to the requirements of Sections 31 23 19 - Dewatering and 31 25 10 - Dust, Soil Erosion and Sediment Control.

2. Care of Water: At all times during the Work, including final inspection, provide and maintain ample means and suitable equipment with which to promptly remove and properly dispose of all water entering excavations or other parts of the Work. Keep all excavations dry at all times until the structures to be built therein are completed and backfilled to approximately final grades except where otherwise approved by the Engineer in writing.

Do not permit sewage from existing sewers and house connections to flow into excavations.

3. To prevent flotation or uplift of the structure or portions of the structure under construction, provide approved dewatering or freezing methods which shall operate under supervision 24 hours per day, including holidays and weekends. Maintain this dewatering or other system in continuous operation until the structure or portions of the structure are substantially completed to a gravity load 10 percent greater than the upward load caused by the ground water uplift pressure measured and computed from the original ground water level. Place backfill and mechanically compact it to approximately final grade after the structure has achieved the required strength, except where otherwise approved by the Engineer in writing. In addition, provide and have available at the work site suitable standby equipment for prompt replacement during breakdowns of operating equipment.

4. The dewatering system shall be maintained in operation as required in Section 31 23 19 – Dewatering.

5. Obtain written approval from the Engineer before discontinuing the dewatering or other groundwater control system.

6. Where water or sewage has accumulated or is flowing in the completed or partly completed structures, remove and dispose of such water or sewage during the time covered by the Contract, unless otherwise directed by the Engineer.

7. The Contractor shall take care of all sewer drainage interfered with by his operations to the satisfaction of the Engineer. Drainage into trench excavations is expressly prohibited.

3.02 IMPLEMENTATION

A. Structure Excavation:

1. Excavations shall be of sufficient size to permit the Work to be safely and properly constructed in the manner and of the size specified, except where limits of excavation are provided on the Contract Drawings. The bottom of the excavation in earth and rock shall have the shape and dimensions of the underside of the structure with allowance for the concrete work mat or compacted aggregate base layer.

2. Exercise care to prevent disturbing or loosening of the soil in the excavation. Densify the bearing surface for all structures with an approved type vibratory compactor to 95 percent of the maximum dry density obtainable by ASTM D1557 before the construction of any foundations. Where the depth of disturbed or loosened soils is greater than 12 inches or; as determined by the Engineer, that it will require special compaction; the Contractor shall propose the appropriate method of compaction and submit to the Engineer for approval. All disturbed or loosened soils as determined

by the Engineer that should be removed shall be replaced in accordance with the requirements of Paragraph 3.03D "Unauthorized Excavation".

3. Whenever abandoned existing piles are encountered during excavation, they shall be cut off at least 18 inches below the bottom of new footings, unless otherwise indicated on the Contract Drawings, and shall not be pulled.

B. Site Excavation:

1. Excavate over the Site within the limits of Site grading to conform to finished Site grades. Arrange the excavation work to permit continuous surface drainage off the Site, eliminate low spots and surface ponding, and prevent runoff from flowing into the surrounding areas.

C. Trench Excavation:

1. Maintain the minimum trench width adequate to place, joint and backfill the pipe or conduit properly. The clear width of the trench at the level of the top of the pipe shall not exceed the sum of the outside diameter of the pipe barrel plus 20 inches for pipe 4 through 24 inches in diameter nor the outside diameter of the pipe barrel plus 2 feet for pipe more than 24 inches in diameter, unless otherwise approved by the Engineer. The banks of pipe trenches shall be as near to vertical as practicable.

2. Length of Excavation: Make excavation for the sewers, drains, ducts, conduits or pipe lines only a reasonable distance in advance of pipe laying, at the discretion of the Engineer, and as may be indicated by the supply of materials on hand.

3. In sheeted trenches, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.

a. Pipes placed in trenches wider than specified above shall be provided with concrete cradle or encasement as directed by the Engineer. No separate payment will be made for such cradles or encasement.

b. Do not overexcavate the bottom of the trenches. The bottom of trenches shall be graded accurately to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length (except for the portions of the pipe sections where it is necessary to excavate for bell hole, for the proper sealing of pipe joints, and as hereinafter specified).

c. Dig bell holes and depressions for joints after the trench bottom has been graded. In order that the pipe rests on the prepared bottom for as nearly its full length as practicable, make bell holes and depressions only of such length, depth, and width as required for properly making the particular type of joint. Remove stones as necessary to avoid point bearing. Except as hereinafter specified for wet or otherwise unstable material, backfill overdepths with

materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe is encountered in the bottom of the trench, over excavate such material (a minimum of 2 feet below pipe) to a depth to allow for construction of stable pipe bedding. Backfill the trench to the proper grade with suitable approved materials as per Section 31 23 23 - Fill.

d. If unstable material is exposed at the level of the bottom of the trench excavation, it shall be excavated in accordance with Paragraph 3.03C "Authorized Additional Excavation". When the Engineer judges that the unstable material extends to an excessive depth, he may advise the Contractor, in writing, to stabilize the trench bottom with additional select fill or pipe bedding material or to ensure firm support for the pipe or electrical duct by other suitable methods. Payment for such trench stabilization will be made as described for "Authorized Additional Excavation."

e. The open, excavated trench preceding the pipe laying operation and the unfilled trench with pipe in place shall be kept to a minimum length, causing the least possible disturbance. Means of egress shall be located so as to require no more than 25 feet of lateral travel by employees. Ladders shall extend a minimum of 36 inches above the top of the sheeting or be tied down with a grabrail provided.

f. No water shall be allowed to rise in the trench excavation until sufficient backfill has been placed to prevent pipe flotation.

D. Lines and Grades:

1. Excavate for sewers, drains, conduits, pipe lines, walls, foundations, footings, and other structures, including any excavating indicated on the Contract Drawings or necessary, to the lines and grades shown on the Contract Drawings, specified or required.

2. Demolition: Cut pavements, curbs and sidewalks with non-impact tools or other equipment approved by the Engineer. Breaking of pavements, curbs and sidewalks by impact, such as with the use of a ball, is not permitted. When removing sections next to sections that are to remain, sawcut the full depth of the concrete and asphalt.

3. Adequate Space: Do all trimming, grading and other incidental work to the grades and slopes shown on the Contract Drawings, specified or required as approved by the Engineer. Perform all excavations of sufficient size for the proper execution and inspection of the work. Keep excavation in good condition at all times and fill all voids which may endanger existing structures to the satisfaction of the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Subgrade Consolidation:

1. Consolidating Suitable Materials: Materials used in the bottom of excavation to replace boggy and other yielding or unsuitable materials, for providing solid and firm foundations for the structures to be built thereon, where approved in writing, may be either select fill or lean concrete.

B. Explosives: Do not use explosives for any clearing, grubbing or excavation work as per Section 31 10 10 – Site Clearing.

C. Authorized Additional Excavation: In case the materials encountered at the elevations shown on the Contract Drawings are not suitable, or in case it is found desirable or necessary to go to an additional depth or to an additional depth and width, carry the excavation to such additional depth and width as the Engineer may direct in writing. Refill such excavated space with either 2,500 psi concrete or compacted select fill materials, as ordered. Where necessary, compact fill materials to avoid future settlement. Use select fill materials meeting the requirements of Section 31 23 23 – Fill and compact to attain a minimum degree of compaction of 95 percent of the maximum dry density as determined by ASTM D1557. Place backfill in lifts not exceeding 9 inches in loose thickness.

D. Unauthorized Excavation: Wherever the excavation is carried beyond or below the lines and grades shown on the Contract Drawings or given by the Engineer, except as specified in Paragraph 3.03C "Authorized Additional Excavation", refill all such excavated space with such material and in such a manner as may be directed by the Engineer to insure the stability of the various structures. Areas excavated beneath all manholes, structures, pipelines or conduits without authority shall be refilled by the Contractor at its own expense with 2,500 psi concrete or compacted select fill material and properly compacted as ordered by the Engineer.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Fencing, Bridging, and Decking

1. All excavations or openings made under this Contract in any public street, park or place, or in any adjoining property, shall be immediately enclosed by a guard fence constructed in a neat and workmanlike manner.

B. Segregation, Storage, and Disposal of Materials:

1. Segregating:

a. All unsuitable material which may be excavated by the Contractor shall be kept separated from suitable excavated material which may be reused on-Site or off-Site under NYSDEC Pre-Determined Beneficial Use or a Case-Specific BUD per 6 NYCRR Part 360, or other applicable out-of-state agency’s Case-Specific BUD, or disposed off-Site.

b. Soil sample results greater than 5 ppm lead by TCLP shall be reported to the Engineer immediately. (See Section 01 35 45 –

Hazardous Materials Control for implementation of a Community Air Monitoring Program (CAMP) in the event that hazardous levels of lead are detected in soil.)

2. Stockpiling:

   a. Excavated material to be used for backfilling on-site under NYSDEC Pre-Determined Beneficial Use or Case-Specific BUD shall be so piled and placed as not to encumber sidewalks or roadways, or wash away or obstruct the free flow of surface or drainage water. Excavated material shall not be placed closer to the edge of an excavation than a distance equal to 1-1/2 times the depth of the excavation, unless the excavation is in rock or the sides of the excavation have been sloped or sheeted and shored to withstand the lateral forces imposed by such superimposed loads.

   b. Stockpile cover and liner material and installation requirements should be as specified in Section 31 25 10 - Dust, Soil Erosion and Sediment Control.

   c. Storage before beneficial use shall not exceed 365 days per 6 NYCRR Part 360.12(d)(2)(vii)(a)(2), unless a different time period for storage is approved by NYSDEC.

3. Excess Materials: The Contractor shall make arrangements for transportation and reuse of the soil on-Site or off-Site under NYSDEC Pre-Determined Beneficial Use or a Case-Specific BUD per 6 NYCRR Part 360, or applicable out-of-state agency's Case-Specific BUD. If reuse is not an option, only then may the Contractor dispose of excess materials.

C. Sheeting and Bracing Left in Place:

1. All sheeting and bracing in excavations for sewer pipelines, including manholes and chambers, shall be left in place except where otherwise shown on the Contract Drawings, specified or ordered in writing by the Engineer. Sheeting left in place shall be cut off at the elevation shown on the Contract Drawings, or at least 18 inches below final grade. Bracing remaining in place shall be driven up tight.

2. Where it is necessary to remove cross braces to make way for sewer pipe, manholes, and chambers, rebrace the sheeting in a manner approved by the Engineer, but in no case shall sheeting be braced against the sides of pipe or structures, unless approved in writing by the Engineer.

3. Leave sheeting and bracing in place in excavations for structures other than pipe lines where shown on the Contract Drawings, specified or ordered in writing by the Engineer to be left in place. Where such sheeting is to be left in place, the original braces shall not be removed and the sheeting shall be rebraced against the structure unless it is approved by the Engineer.

4. Sheeting and bracing to be left in place shall include all elements of the sheeting and bracing regardless of the type used, except such braces

required to be removed to make way for the structure or pipeline being constructed. Where lagging and "soldier" beams are used, the "soldier" beams shall also be left in place.

5. In excavations with vertical sides for the full depth, cut off sheeting left in place at the elevations provided in writing by the Engineer, but in general, such cutoffs shall not be less than 18 inches below the existing ground surface. In excavations with sloped sides above and vertical sides below, cut off sheeting at the top of the vertical sides of the excavation. Cut off timber sheeting by sawing, and steel sheeting or "soldier" beams by burning. Breaking off sheeting will not be permitted.

6. Do not remove sheeting and bracing not shown on the Contract Drawings or specified to be left in place without first obtaining a statement in writing from the Engineer that such sheeting may be removed.

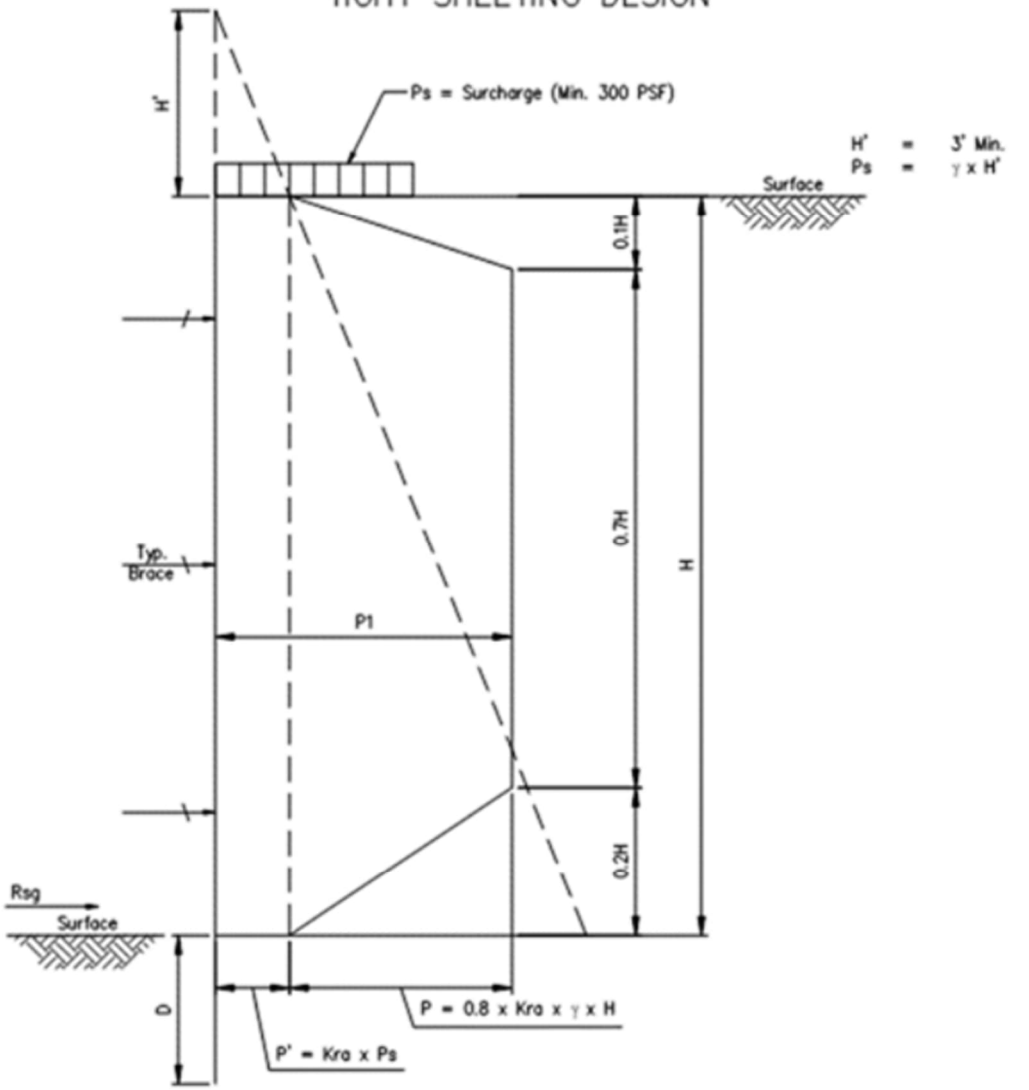
7. No separate payment will be made for sheeting and bracing left in place, the cost thereof shall be included in the price or prices bid for the Work under this Contract, except when separate payment for sheeting and bracing ordered in writing by the Engineer to be left in place is provided for in the Contract Documents.

END OF SECTION

Attachment A

(Revised 10/22)

MINIMUM LOAD DIAGRAM FOR NON–WATER TIGHT SHEETING DESIGN



δ = Unit Weight of Soil

δw = Unit Weight of Water

δs = Unit Weight of Submerged Soil

ø = Angle of Internal Friction of Soil

$Kra = \frac{(1 - \sin \phi)}{(1 + \sin \phi)}$ For Active Earth Pressure

$Krp = \frac{(1 + \sin \phi)}{(1 - \sin \phi)}$ For Passive Earth Pressure

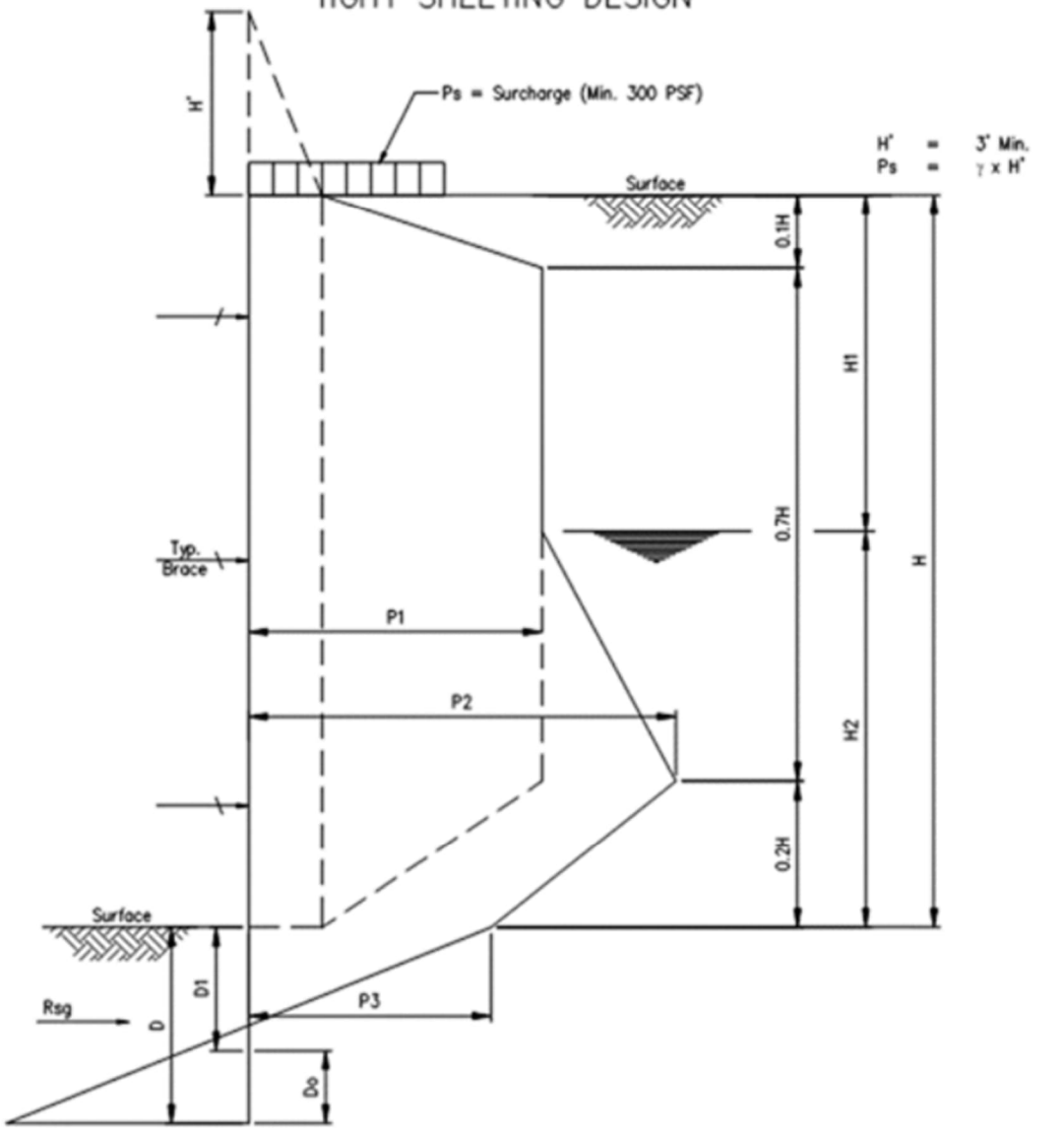
$D = \sqrt{\frac{2\ Rsg}{\delta (Krp - Kra)}}$ (1.3)

(Min. 2'–0")

Attachment B

(Revised 10/22)

MINIMUM LOAD DIAGRAM FOR WATER TIGHT SHEETING DESIGN



$$P' = Kra \times Ps$$

$$P1 = P' + 0.8 \times Kra \times (\delta H1 + \delta s H2)$$

$$P2 = P1 + \delta w\ (H2 - 0.2H)$$

$$P3 = \delta w \times H2$$

$$D1 = \frac{P3}{\delta s\ (Krp - Kra)}$$

$$Do = \sqrt{\frac{2\ Rsg}{\delta s\ (Krp - Kra)}}$$

$$D = (D1 + Do)\ (1.3)$$

NO TEXT ON THIS PAGE

SECTION 31 23 19 – DEWATERING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install, operate and maintain dewatering equipment and systems as specified, shown on the Contract Drawings, or required during the Contract.

B. The Contractor shall provide standby equipment and power supply for maintaining uninterrupted construction dewatering.

C. The Contractor shall install groundwater monitoring wells/piezometers and measure, record and report the levels/hydraulic head of groundwater as required during the Project.

D. The Contractor shall obtain and comply with all necessary permits from State and local agencies having jurisdiction for operation of the dewatering system, monitoring groundwater, and disposal of dewatering effluent, and shall bear all costs and schedule impacts associated with maintaining, renewing and modifying permits.

E. The Contractor shall collect samples of the dewatering effluent as required by the applicable State and local permits and provide the services of a laboratory certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for the analyses of the samples collected to determine the quality of dewatering effluent prior to disposal.

F. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Implementation	8

3.03 Field Testing / Quality Control 11
3.04 Startup / Demonstration 11
3.05 Adjusting / Protection / Cleanup.....11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 02 24 20 - Soil Sampling and Analysis

B. Section 31 23 16 - Excavation

C. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

1.04 REFERENCES

A. Definitions

1. Construction Dewatering: Controlling groundwater levels, hydrostatic pressures and controlling surface water, such that excavation required on the Contract Drawings can be performed to required depths in substantially dry and stable conditions.

2. Dewatering System: System of wells, well points, sumps, ejectors, pumps, piping, power supply, effluent treatment equipment and other equipment designed by the Contractor, submitted to and approved by the Engineer prior to dewatering, that will effectively dewater the Site as required herein. Adequate monitoring wells/piezometers shall be included in the dewatering system to verify drawdown levels inside the excavation area and monitor groundwater levels outside the limits of the excavation near adjacent structures.

B. Reference Standards

1. 6 NYCRR Part 750, State Pollutant Discharge Elimination System (SPDES) Permits

2. 6 NYCRR Part 601, Water Withdrawal Permitting, Reporting and Registration (Exclusive of Long Island Wells Regulated Under Part 602 of This Title)

3. 6 NYCRR Part 602, Applications for Long Island Wells

4. 6 NYCRR Part 621, Uniform Procedures

5. NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009 or latest version

6. Water and Sewer Forms, New York City Department of Environmental Protection; (http://www.nyc.gov/html/dep/html/forms_and_permits/wsforms.shtml)
7. New York City Construction Code
8. ASTM standards applicable to piping, equipment and other items required for a complete dewatering system

1.05 DESCRIPTION

A. Design Requirements

1. The Contractor shall design, install, operate, maintain and remove the dewatering system as necessary to:
    a. Lower and maintain groundwater levels and hydrostatic pressures to 2 feet below the prevailing excavation level or to a point no higher than 2 feet above the top of an impermeable stratum, if the subgrade is in the impermeable stratum. Groundwater levels shall be lowered for a time period as deemed necessary by the Engineer to ensure adequate factor of safety for the constructed structure.
    b. Maintain stable slopes and subgrade.
    c. Control and remove seepage and surface water into excavations.
    d. Allow subsequent work to be safely performed and not result in damage to adjacent properties, buildings, structures, utilities and other work.
    e. The Contractor shall provide primary and standby power, including all costs for installation, energy and fuel.
    f. The Engineer will perform inspections and witnessing of:
        1) Testing of sand and silt from dewatering wells.
        2) Drawdown and performance testing of Dewatering System.
        3) Performance testing of standby power source and backup Dewatering System.
2. The method of dewatering and control of water both inside and outside the excavation shall be per the Project's Stormwater Pollution Prevention Plan (SWPPP) and selected by the Contractor who shall be solely responsible for the location, arrangement and depth of any system(s) selected to accomplish the Work. The Contractor shall construct protective works as necessary to dewater, cut off porous zones of fill and direct the flow of water from whatever source away from the excavations and adjacent areas. Protective works shall include slurry methods, grouting, clay seepage plugs, toe drains with appropriate filters, deep wells, well points, sumps, dikes, ditches and all supporting features as required, but not specifically shown on the Contract Drawings.

a. The dewatering system shall be designed and implemented so as to maintain a minimum factor of safety against the uplift groundwater pressures in any soil strata. The factor of safety shall be calculated by considering the stabilizing pressure to consist of overburden soil weight alone. The dewatering system shall be maintained operational until the dead weight of the overburden soil plus any completed portion of the structure is able to provide the required factor of safety at static (normal) groundwater level / pressure.

3. The dewatering system shall be designed to treat dewatering effluent to comply with all necessary permits and/or applications for disposal of dewatering effluent.

B. Regulatory requirements

1. The Contractor shall manage and dispose of all groundwater removed during dewatering activities in accordance with New York City DEP Sewer Discharge Criteria for discharge to the City wastewater collection system. The Contractor shall acquire, and update as necessary, all permits and/or applications for water withdrawal and disposal of dewatering effluent. It shall be the Contractor's responsibility to update permits to match their final dewatering system design.

2. For discharge to the City wastewater collection system, a comparison of the site groundwater quality data (before and after any treatment proposed by the Contractor) with the NYCDEP Limitations for Effluent to Sanitary or Combined Sewers (latest version issued by the Division of Pollution Control and Monitoring, Bureau of Wastewater Treatment) shall be required prior to and during effluent discharge.

1.06 QUALITY ASSURANCE

A. The dewatering Work shall be performed by an entity specializing in and having experience with installing and operating dewatering systems in similar subsurface conditions for at least 5 years.

B. The dewatering system shall be designed by a Professional Engineer registered in the State of New York having experience in designing a system in similar Site conditions.

C. Well drillers shall be licensed in the State of New York.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and the following for the approval by the Engineer:

1. Pre-construction Submittals: A Dewatering Plan shall be submitted to the Engineer for approval, at least 30 calendar days prior to the scheduled date for commencement of the dewatering Work. Approval of the Dewatering Plan by the Engineer or City shall not in any way relieve the Contractor from full responsibility for the complete and adequate design and

performance of the dewatering system to provide the necessary construction dewatering. At a minimum, the Dewatering Plan shall include the following:

a. Design calculations confirming the adequacy of the proposed dewatering system, including depths to groundwater within the excavation limits.

b. Calculations and requisite technical data on well screens and filter materials and gradations to demonstrate the adequacy of proposed systems to prevent the pumping of fines.

c. Shop drawings showing the proposed types and planned locations of surface water control and the dewatering system to be used.

d. Shop drawings shall include the arrangements, locations and depths of the dewatering system, a complete description of equipment and materials to be used and the procedures to be followed in installation, operation and maintenance in relation to the proposed sequence of excavation, foundation construction and backfilling.

e. The standby equipment and standby power supply details.

f. The proposed locations and sizes of effluent treatment equipment, effluent flow equalization tanks and discharge of water.

g. Location and size of sumps, ditches and water discharge lines, including their relation to water disposal points.

h. Submittals shall also include discharge details, metering, and monitoring schedules and the details of the settling tank and oil/water separator.

i. Methods and equipment to be used for drilling, construction, and development of wells and piezometers.

j. Protocols to be followed for the sampling and analysis of dewatering effluent, and the name and qualifications of the laboratory that will be testing the quality of dewatering effluent prior to disposal.

k. Protocols to be followed for treatment of effluent in conformance with the requirements of the applicable permits.

2. As required in Section 02 24 20 - Soil Sampling and Analysis, the Contractor shall submit a completed EH&S Drilling and Boring Checklist for approval to the Engineer

3. As-built Submittals: Prior to the start of construction dewatering, submit as-built conditions of the dewatering system. As-built data are to include but are not limited to:

a. Plans and sections showing as-built locations, and surveyed elevations of the dewatering system and its components.

b. Drawings to indicate changes made to the original Shop Drawings to accommodate field conditions and to comply with design standards.

c. Details of installation including dimensions and materials used, description and drawings of all installations, all procedures, soil strata encountered and logs with descriptions of soil samples and stratification.

d. Details of each sump, well, well point, observation well, and piezometer installed, including, but not limited to, the diameters of the borehole and the components, screen type, screen opening size, screen top and bottom elevations, details of filter, seal and grout, pump type, and capacity if installed within. These details should be provided to the Engineer within a week of installation of each entity. The details shall be re-submitted if any part of the entity changes during construction.

e. Details of abandoning each sump, well, well point, observation well, and piezometer after its use has been completed.

4. Regulatory Compliance: Prior to the start of construction dewatering, submit a report comparing site groundwater quality data with the water quality standards to be complied with under permit(s) as applicable to the project. The permitting requirements to be considered under the Work of this section include, but may not be limited to:

a. NYCDEP Dewatering Permit for temporary groundwater discharge into the public sewers of the City.

1) Wastewater Quality Control Application and Letter of Approval, if applicable, from the Inspection & Permitting Section, Industrial Pollution Prevention (IPP) Program, Division of Pollution Control and Monitoring, Bureau of Wastewater Treatment (BWT).

2) Letter of Approval from the Division of Connection and Permitting, Bureau of Water & Sewer Operations (BWSO), if applicable.

3) NYC DEP Bureau of Customer Service Permit

b. Water Withdrawal and Long Island Well Permits, if applicable, in association with construction dewatering.

c. The Contractor shall be responsible for compliance with all dewatering permit requirements including renewals once construction dewatering begins.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The settling tank shall be concrete or steel as manufactured by Rockford, Belvidere, IL or an approved equal,

B. The oil/water separator shall be concrete or steel as manufactured by Rockford, Belvidere, IL or an approved equal.

2.02 MATERIALS / EQUIPMENT

A. Materials and equipment used in the dewatering system shall adhere to accepted industry standards and be in good operating condition and able to perform satisfactorily over the required duration of construction dewatering.

B. Back up equipment for the dewatering system shall be identical to the primary equipment and shall be available in operating condition at all times.

C. Pipes and well screens shall consist of Schedule 40 PVC or stronger.

D. Sand shall consist of clean, single-size filter sand of adequate gradation.

E. Grout shall consist of cement-bentonite grout of adequate mix proportion and consistency. Seals shall consist of bentonite pellets.

F. Pumps, meters, hoses and controls shall be suitable for the intended purpose and application.

G. Power supply and effluent discharge are included in this Work.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Construction dewatering is required to protect foundation subgrades and to maintain dry and stable conditions for construction. The Contractor shall maintain

a continuous and completely effective Dewatering System for the required time as specified in Section 31 23 16 - Excavation.

B. The Contractor shall obtain and pay for all permits, applications and licenses required by law that are associated with the disposal of dewatering effluent . The Contractor shall coordinate with the CM and DEP to obtain or modify permit(s), if necessary, sufficiently in advance of dewatering system startup. The Contractor shall also maintain the permits by applying for and following up on the applications for modifying or renewing the permits, if necessary, during the period of performance.

C. The Contractor shall coordinate the operation of the dewatering system with any other Work.

D. The Contractor is responsible for monitoring dewatering efforts to determine if the Contract and related permit requirements are being met. The Contractor shall provide observation wells and other means to monitor the dewatering as detailed in the Dewatering Plan.

E. Surface areas adjacent to the excavation shall be graded and/or curbed to prevent flow of surface water into the excavation.

F. Open pumping with sumps and ditches resulting in boils, loss of fines, softening of the ground or instability of slopes will not be permitted.

G. The Contractor shall select and supply Personal Protective Equipment (PPE) in accordance with the Contractor's Site Health and Safety Plan.

3.02 IMPLEMENTATION

A. The dewatering system shall provide for an uninterrupted flow of pumped water and shall be maintained and pumped as necessary to drawdown and maintain the groundwater levels as specified. Unless otherwise specified, pumping shall maintain those depressed levels until the permanent under drainage system has been installed, tested, accepted and is operational or until the permanent structure, or a portion thereof, is capable of withstanding hydrostatic pressures as determined by the Engineer.

B. The Contractor shall furnish, operate and maintain sufficient drainage and pumping facilities to dewater the site and its underlying soil. Dewatering operations shall operate in such a manner so that the excavation can proceed while maintaining stable slopes and the designed lateral support for the perimeter support of excavation walls, without disturbing the bearing subgrades for the structure and provide stable conditions. The ground water level as measured in observation wells shall be lowered and maintained at least two feet below the prevailing excavation level, or it shall be lowered to a point no higher than 2 feet above the top of impermeable stratum if the subgrade is in the impermeable stratum.

C. The dewatering system shall be installed and operated in such a manner as to avoid the movement of fines or loss of ground below the bearing level and shall not influence the stability of surrounding areas. Well points and deep wells shall be

properly sanded in and sumps shall be sheeted and provided with proper filter material.

D. Any sign of subgrade disturbance due to seepage or unaccountable reduction in effluent flow rate shall be immediately reported to the Engineer and steps immediately taken to correct the condition.

E. The Contractor shall install observation wells / piezometers and monitor groundwater lowering at nearby structures due to construction dewatering. Any damage caused to nearby structures due to construction dewatering shall be repaired by the Contractor at no cost to DEP.

F. Surface Water

1. Surface water on and around the site shall be collected into local sumps by means of trenches, pipes, or other means. The Contractor shall discharge the water into the City wastewater collection system. Direct surface water to the proper drainage system to minimize surface erosion, ponding and softening of slopes and berms, including haul roads and equipment working stations. Slope protection by means of polyethylene sheets, held in place by tires or otherwise, shall be provided locally as required. At the perimeter of the excavation, surface water is to be directed into the storm sewer system and not permitted to enter the excavation. Curbs shall be maintained and, where necessary, extended across intersections, curb cuts and defective curb sections. Surface cracks in the adjacent streets are to be sealed and re-sealed as necessary. Should adjacent settlement occur during the work, curbs shall be raised or water-tight mounds shall be installed as directed by the Engineer to prevent flow into the site. Measures for preventing the pollution of and discharging storm water shall be in accordance with Section 31 25 10 - Dust, Soil Erosion and Sediment Control.

   a. If surface water flows to a point across a potentially contaminated surface (e.g., contaminated or hazardous soils) or otherwise unsuitable/impermeable surface (e.g., mud mat), removal of said water via pumping to storm sewers shall require the appropriate dewatering permits from the NYCDEP Bureau of Water and Sewer Operations (BWSO) Division of Permitting and Connections. The Contractor shall obtain all necessary permits in a timely manner so as not to delay the Work.

G. Pretreatment of dewatering effluent

1. The Contractor shall provide appropriately sized settling tanks to collect and store dewatering effluent commensurate with dewatering discharge rates to allow for settlement of suspended solids and sampling as required by disposal/discharge criteria. The tanks shall be equipped with an overflow collection system to prevent accidental release of dewatering effluent. Routine inspection of the tanks shall be carried out daily to ensure that tank integrity is being maintained, and that all valves or tank openings are properly locked out to avoid accidental discharge. Settling tanks shall be

cleaned frequently to prevent excess deposition of solids which could overflow from the tank. Removed solids shall be classified and disposed of in accordance with the requirements of Section 02 24 20 - Soil Sampling and Analysis. Transportation and Disposal including waste manifests shall be in accordance with Section 31 23 16 - Excavation).

a. The settling tank shall be sized based upon the maximum groundwater flow times a 1.5 safety factor.

2. The Contractor shall provide appropriately sized oil/water separators to prevent discharge of hydrocarbons, grease and other floatable materials to surface water or the sewer system. Oil/water separators shall be cleaned frequently and collected materials classified and disposed of in accordance with Sections 02 24 20 - Soil Sampling and Analysis and 31 23 16 - Excavation requirements for manifests and material transport and disposal.

a. The oil/water separator shall be sized based upon the maximum groundwater flow times a 1.5 safety factor.

3. The Contractor shall provide treatment for, or remove from the Site to an approved disposal facility, all dewatering effluent or groundwater which exceeds any limit set for surface water or sewer discharge, whichever is applicable. Classification and disposal shall conform to Sections 02 24 20 - Soil Sampling and Analysis and 31 23 16 - Excavation requirements for manifests and material transport and disposal.

H. Disposal of Dewatering Effluent

1. Dewatering effluent may be affected by rainfall. The Contractor shall provide adequate equalization and holding tanks to allow work to proceed in the case of restricted discharge capability during rain events.

2. The Contractor shall provide sufficient clean water to flush all sewers and drains when necessary. If any sewer, drain, catch basin, or inlet becomes filled or partially filled with sediment or debris, the Contractor shall promptly and satisfactorily remove such deposits.

3. The Contractor shall collect dewatering effluent samples as required by the permits and the Dewatering Plan. If pretreatment, other than oil/water separators and settling tanks, is required, the Contractor shall continue to collect effluent samples during dewatering operations, and analyze for all listed parameters at intervals based on dewatering discharge volume as a verification of discharge compliance. Intervals will be as defined in the Dewatering Plan. A copy of all analytical results shall be submitted to the Engineer for review and approval, no later than one day after receipt of such data. The Contractor shall provide for prompt sampling and turn-around times so as not to delay the project, but in no case shall turn-around time be longer than 5 calendar days.

3.03 FIELD TESTING / QUALITY CONTROL

A. The Contractor shall determine the presence of contaminants in dewatering effluent, including the quantity of fines in the pumped water, by sampling and analyzing in accordance with permit requirements, or once every two weeks, whichever is more frequent.

B. The fines content should be measured in each sump, well or well point being pumped. The permissible maximum fines content is 5 parts per million (ppm) as measured by the Rossum Sand Content tester. If the fines content is exceeded, the Contractor shall modify or re-install the well or wellpoint to satisfy the requirements.

C. The Contractor shall measure water levels periodically in observation wells / piezometers installed adjacent to nearby structures to ensure drawdown outside the excavation is within allowable limits in accordance with applicable permits.

D. A sufficient number of observation wells shall be installed and water levels monitored by the Contractor, at least weekly, to demonstrate that the goals of the Dewatering System are being met. If applicable, the Contractor may make use of existing observation wells as shown on the Contract Drawings.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. The Contractor shall be prepared to modify the dewatering system and methods as required by actual field conditions encountered during construction, at no additional cost to DEP. Any component of the dewatering system that malfunctions or is damaged during its operation shall be promptly repaired or replaced by the Contractor at no additional cost to DEP.

B. All wells and piezometers shall be decommissioned at the completion of the work, except as directed by the Engineer, in accordance with NYSDEC CP-43 Policy.

C. All wells shall be decommissioned and all other portions of the dewatering system shall be removed by the Contractor after completion of dewatering activities and in accordance with NYSDEC requirements.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Fill Work includes furnishing, placing and compacting all fill material necessary to bring excavations and Site work to final grade as shown, specified or required.

B. Clean fill material from an off-Site source shall be non-hazardous and shall meet the requirements of this Section.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	6
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Implementation	10
3.03	Field Testing / Quality Control	13
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 74 20 - Construction Waste Management

B. Section 02 24 20 – Soil Sampling and Analysis

C. Section 03 30 00 - Cast-in-Place Concrete

D. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

E. Section 32 90 00 - Planting

1.04 REFERENCES

A. Definitions

1. Case-Specific Beneficial Use Determination (BUD): Under 6 NYCRR Part 360, Section 360.12(d), NYSDEC sets forth the requirements for petitioning NYSDEC to obtain a Case-Specific BUD, and the criteria for reviewing, granting, or denying of the BUD. For reuse of a solid waste to be determined a beneficial use, the petition must satisfy all criteria outlined under 6 NYCRR Part 360, Section 360.12(d).

2. Fill: Soil and similar material excavated or brought to the project site for the purposes of construction. All fill material must meet the requirements of this Section. It does not include overburden generated from mining operations.

3. New York City Metropolitan Area Waste Impact Zone: The area encompassing the City of New York and the counties of Nassau, Suffolk, Putnam and Westchester, as per 6 NYCRR Part 360.2 Definitions.

4. Pre-Determined Beneficial Use for fill material: Under 6 NYCRR Part 360, Section 360.13(b) Waste cessation. "Excavated material ceases to be solid waste in accordance with the following:

   a. Fill Type 1 generated outside of the New York City Metropolitan Area Waste Impact Zone (NYCMAWIZ) – once a determination has been made that the material is Fill Type 1;

   b. Fill Type 1 generated within Nassau, Suffolk, Westchester and Putnam Counties – once the material is delivered to the site of reuse;

   c. Fill Type 1 cannot be generated within the City of New York;

   d. Fill Type 2 and Fill Type 3 generated outside of the NYCMAWIZ – once a determination has been made that the material is Fill Type 2 or Fill Type 3;

   e. Fill Type 2 and Fill Type 3 generated within the NYCMAWIZ – once the material is delivered to the site of reuse;

   f. Fill Type 4 and Fill Type 5 – Once the material is delivered to the site of reuse."

   g. Under 6 NYCRR Part 360, Section 360.12(c)(1)(iv)(a), Excavated material used to backfill the same excavation or as grade adjustment in areas of similar physical characteristics on the site of generation. If the material exhibits visual or historical evidence of contamination (including odors) and will be used in an area with public access, the material must be covered with pavement, foundation, or with a minimum of 12 inches of soil or fill that meets the criteria to be used as Fill Type 1 and Fill Type 2 as defined in Subdivision 360.13, Special requirements for pre-determined

beneficial use of excavated material. Refer to Section 02 24 20 - Soil Sampling and Analysis for sampling requirements, including a list of parameters to be analyzed for soils to be reused on-site, or soils to be reused or disposed off-site.

5. Suitable Material: Any material whose composition is satisfactory for use as fill. Any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man-made (i.e. recycled) origin, including mixtures thereof, are considered suitable materials. Determinations of whether a specific natural material is suitable shall be made by the Engineer on the above basis.

6. Unsuitable Materials: any material containing vegetable or organic matter such as muck, peat, organic silt, topsoil or sod, that is not satisfactory for use as fill material.

B. Reference Standards

1. ASTM C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
3. ASTM C330 - Lightweight Aggregates for Structural Concrete
4. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils
5. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
6. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
7. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m^3))
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
9. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
10. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Cylinders
11. ASTM D6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
12. ASTM D6024 - Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application

13. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
14. NYSDEC regulations, 6 NYCRR Part 375, Environmental Remediation Programs
15. NYSDEC regulations, 6 NYCRR Part 360, Solid Waste Management Facilities General Requirements
16. NYC Building Code
17. NYS Standards and Specifications for Erosion and Sediment Control (aka "Blue Book") (NYSDEC, latest edition)

1.05 DESCRIPTION

A. Recycled materials that the Engineer has evaluated and approved for general use shall be considered to be Suitable Material subject to the conditions for use as determined by DEP. In general, the use of recycled materials must be sanctioned by NYSDEC, usually in the form of a BUD. See definition above.

B. Suitable fill material from an off-site source shall be non-hazardous and shall come from the following hierarchical sources:

1. Other DEP projects that have available, excess suitable materials;
2. The NYC Clean Soil Bank, located at 830 Forbell Street, Brooklyn, and managed by the Mayor's Office of Environmental Remediation (OER);
3. Beneficial Use Facilities; and
4. Commercial Facilities.

1.06 QUALITY ASSURANCE

A. Testing: The Contractor shall retain the services of an independent materials testing laboratory to perform the following laboratory and field tests.

B. All materials used in construction, whether brought to the site or developed from on-site sources, shall be tested for optimum moisture-maximum density curve, and reports of the test results for each source shall be submitted promptly. The tests shall be as follows:

Test	ASTM Standard	Tests Per Volume Delivered
Gradation	D422	1 per 200 C.Y.
Compaction or Density	D1557	1 per 200 C.Y.

C. Acceptability of completed compaction shall be demonstrated by tests performed by the Contractor and accepted by the Engineer. The minimum number of tests shall be determined by quantity of material placed, and reports of the test results shall be submitted promptly. The Contractor shall perform either of the following tests subject to the approval of the Engineer:

Test	ASTM Standard	Tests Per Volume Placed
In-Place Density	D2167 D6938	1 per 200 cy

D. Any fill material being brought to the Site that is composed of soil or a mixture of soil (excluding gravel, crushed stone, limestone screenings, or other granular materials), as well as any soil being used for drainage fill, common fill and pipe bedding for small piping, must comply with the following protocol:

1. Testing shall be performed on all soil brought on-site (fill and topsoil) and shall demonstrate chemical quality meeting 6 NYCRR Part 360, Section 360.13(f), Table 2: Fill Material Beneficial Use, specifically Fill Type 2 maximum concentration levels.

2. Chemical analyses shall include the 6 NYCRR Part 375-6.8(b) compounds, including volatile organic compounds and asbestos, as detailed in Section 02 24 20 - Soil Sampling and Analysis. All analyses shall be performed by a testing laboratory certified by the New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH-ELAP). Based on visual observation, the volume of physical contaminants, if present, shall also be recorded

3. The frequency of testing per volume of fill shall be:

   a. 1 per 500 CY of material purchased from a registered/permitted or recycling facility; or

   b. 1 per 1000 CY of native materials (e.g., non-regulated soil and sand with no mandate materials) purchased from an operating gravel pit or similar facility.

4. Notification to the NYSDEC must be made prior to the first load greater than 10 cubic yards is planned to be transported from the site of excavation directly to the site of reuse.

   a. At least five days in advance of transfers of Fill Types 2, 3, 4 and 5 generated in, imported to, or relocated within the City of New York.

   b. At least five days in advance of transfers of Fill Type 4 and Fill Type 5 anywhere in the State of New York.

   c. The Notification of Fill Transfer for Reuse form (NYSDEC Division of Materials Management, version 03/24 or latest) will be sent to the NYSDEC Regional Office in which the destination is located. The form must be certified by a Qualified Environmental Professional (QEP). In the event the QEP is not a Professional Engineer or Geologist licensed in New York State, the QEP's basis for credential must be attached to the form.

E. When testing is required to confirm the reuse of on-site excavation spoils under a Case-Specific BUD, sample the soils in accordance with NYSDEC and Section 02 24 20 – Soil Sampling and Analysis requirements.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Name and location of all suppliers.
2. Certificate of compliance with standard specified for each source of material.
3. The Contractor shall submit all laboratory analytical reports, which shall include a Summary Table listing the analytical results with highlighted exceedances as defined in 6 NYCRR Part 360, Section 360.13 (f), Table 2: Fill Material Beneficial Use, as applicable.
4. Prior to stockpiling or placing of select fill materials at the job Site, submit for approval approximately 100-pound samples representative of the fill at the proposed borrow source. In addition, submit documentation of the availability of the required fill quantities at any proposed borrow source.
5. Submit optimum moisture – maximum density curves and reports for all fill materials before placement of fill.
6. Results of all compaction tests for fill placement.

B. Prior to the transfer of fill, the Contractor shall submit the Notification of Fill Transfer for Reuse form for review prior to being sent to the NYSDEC. The form must be certified by a Qualified Environmental Professional (QEP). In the event the QEP is not a Professional Engineer or Geologist licensed in New York State, the QEP's basis for credential must be attached to the form. NYSDEC must receive notification at least five days in advance of transfers of Fill Types 2, 3, 4 and 5 generated in, imported to, or relocated within the City of New York and at least five days in advance of transfers of Fill Type 4 and Fill Type 5 anywhere in the State of New York.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered to the site shall be stored in a manner to prevent contamination and segregation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. General

1. Backfill shall be composed of suitable materials as defined in this Section.

a. On-Site Materials: Material to be excavated and proposed for reuse as fill under Pre-Determined Beneficial Use must meet the requirements of 6 NYCRR Part 360, Section 360.13 (a), Applicability, Section 360.13 (b), Waste Cessation, or 360.12(c)(1)(iv)(a), Excavated material used to backfill the same excavation or as grade adjustment in areas of similar physical characteristics on the site of generation. If these criteria cannot be met, material shall meet Section 360.12(d), Case-specific beneficial use determinations - general. Fill may require sampling and analyses in accordance with Section 02 24 20 – Soil Sampling and Analysis designed and implemented by or under the direction of a qualified environmental professional (QEP). The Contractor shall maximize reuse of soil on-site for backfilling rather than import soil from other sources.

b. Off-Site Imported Materials: Fill that is brought on site to be used as backfill must meet the requirements of 6 NYCRR Part 360, Section 360.13 (f), Table 2: Fill Material Beneficial Use for General Fill.

2. Follow common fill requirements whenever drainage or select fill is not specified. Determine and obtain the approval of the Engineer for the appropriate test method where more than one compaction test method is specified.

3. Do not use wet or frozen material for backfilling.

4. The maximum stone size shall be two-thirds of the thickness of the backfill lift, but in no case shall material containing stones over 10 inches in the largest dimension be used for backfill.

B. Drainage Fill

1. Use clean gravel, crushed stone, or other suitable material conforming to the gradation specified for drainage fill. Clay and fine particles are unacceptable in drainage fill. Provide drainage fill that complies with the following gradation limits:

U.S. Standard Sieve	Percent Passing By Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	45-65
#4	5-15
#16	0-4

2. For porous pavement drainage layer, use AASHTO #57 aggregate material.

C. Select Fill

1. Use gravel, crushed stone, limestone screenings or other granular or similar materials, as approved, which can be readily and thoroughly compacted to not less than 95 percent of the maximum dry density obtainable by ASTM D1557. Very fine sand, uniformly graded sands and gravels, or other materials that have tendency to flow under pressure when wet are unacceptable as select fill. Provide select fill that complies with the following gradation limits:

U.S. Standard Sieve	Percent Passing By Weight
2 inch	100
1-1/2 inch	90-100
1 inch	75-95
1/2 inch	45-70
#4	25-50
#10	15-40
#200	5-15

D. Common Fill

1. Material from on-Site excavation may be used as common fill provided that it can be readily compacted to not less than 90 percent of the maximum dry density obtainable by ASTM D1557, and does not contain unsuitable material as per Article 1.04.A.5 Select fill may be used as common fill at no change in the Contract Price.

2. Granular on-site material that complies with the following gradation limits may be used as granular common fill:

U.S. Standard Sieve	Percent Passing By Weight
3 inch	100
#10	50-100
#60	20-90
#200	0-20

3. Cohesive Site material may be used as common fill as follows:

a. The gradation requirements do not apply to cohesive common fill.

b. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20, as determined by ASTM D4318.

4. All material used as common fill is subject to approval by the Engineer. If there is insufficient suitable material on site, import whatever additional material is required which conforms to the sections, at no additional cost to DEP.

E. Pipe Bedding

1. Gradation for Small Piping: For pipe 18 inches or less in diameter, use pipe bedding material of which 90 percent will be retained on a No. 8 sieve and 100 percent of which will pass a 1/2-inch sieve and be well graded between those limits.

2. Gradation for Large Piping: For pipe larger than 18 inches in diameter, use the same pipe bedding material as specified for smaller pipe or use a similar well graded material of which 90 percent will be retained on a No. 8 sieve, 100 percent will pass a 1-inch sieve, and will be well graded between those limits.

F. Compaction Equipment

1. Equipment and Methods: Perform all compaction with suitable approved equipment and methods.

2. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use handheld pneumatic tampers elsewhere for compaction of cohesive fill material.

3. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.

4. Do not use heavy compaction equipment over pipelines or other structures, unless the depth of fill is sufficient to adequately distribute the load.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. All stockpiled materials shall be adequately handled as required in Section 31 25 10 – Dust, Soil Erosion and Sediment Control.

B. No material shall be placed until satisfactory test reports for material type and compaction requirements have been approved by the Engineer.

C. Warning tape/ribbon shall be placed and/or restored as required when backfilling new and existing utility lines.

3.02 IMPLEMENTATION

A. Backfill all excavations to the original surface of the ground or to such other grades as may be shown or required. For areas to be covered by lawn mix, leave or stop backfill 12 inches below the finished grade or as otherwise required to provide adequate depth of lawn mix to satisfy the requirements of Section 32 90 00 – Planting.

B. Remove from all backfill, and from the space being backfilled, any compressible, putrescible, or destructible rubbish and refuse before backfilling is started. Dispose of the rubbish and refuse in accordance with the requirements of Section 01 74 20 – Construction Waste Management.

C. Leave sheeting and bracing in place or remove as the Work progresses, as shown in the Contract Drawings, specified or directed by the Engineer.

D. Do not permit backfilling construction equipment to travel against or over cast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified provided the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.

E. Electrical Duct and Structure Bedding

1. All electrical ducts and precast manhole bases shall be bedded in well graded, compacted, select fill material. Select fill shall be placed in uniform layers not greater than 9 inches in loose thickness and compacted in place with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D1557. Bedding thickness shall be not less than 6 inches after compaction. Bedding below electrical ducts shall extend the full width of the trench.

2. Existing underground structures, tunnels, conduits and pipes crossing the excavation shall be bedded with compacted select fill material. Place bedding material under and around each existing underground structure, tunnel, conduit or pipe and extend underneath and on each side to a distance equal to the depth of the trench below the structure, tunnel, conduit or pipe.

3. Cast-in-place manhole bases and other foundations for structures shall be cast against a concrete work mat in clean and dry excavations, unless otherwise shown, specified or required.

F. Pipe Bedding and Initial Backfill

1. Place select fill by hand for initial pipe backfill from top of bedding to 1 foot over top of pipes in uniform layers not greater than 6 inches in loose

thickness. Tamp under pipe haunches and thoroughly compact in place the select fill with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D1557.

2. Do not place stone fragments larger than 2-inch size in the pipe bedding or in the backfill to 1 foot over the top of pipes, nor any stone fragments larger than 3-inch size nearer than 2 feet from any pipe, conduit or concrete wall.

3. Pipe bedding containing very fine sand, uniformly graded sands and gravels, or other materials that have a tendency to flow under pressure when wet is unacceptable.

4. Bed pipelines or electrical ducts placed in short tunnels in select fill, or 2500 psi concrete. Completely fill the remainder of the annular space between the outside of the pipe wall and the tunnel wall with select fill, suitable job-excavated material, or 2500 psi concrete, as approved. Pipes and ducts in short tunnels shall be supported to permit placing and compaction of backfill.

G. Trench Backfill

1. Backfill trenches from 1 foot over the top of the pipe, from the top of electrical duct bedding or as shown to the bottom of pavement base course, subgrade for lawns or lawn replacement, to the top of the existing ground surface or to such other grades as may be shown or required. Backfill trenches as soon as, in the opinion of the Engineer, it can be done without injury to the concrete or pipe lines.

2. Provide select fill, suitable job-excavated material or other material, as specified and as approved for trench backfill.

3. Depth of Placement - General: Except under pavements, walkways, railroad tracks, and street or highway appurtenances, or as otherwise specified, place trench backfill in uniform layers not greater than 9 inches in loose thickness and thoroughly compact in place using suitable mechanical or pneumatic equipment. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D1557.

4. Depth of Placement - Traffic Areas and Under Utilities: Where pavements, walkways, railroad tracks and street or highway appurtenances are to be placed over trenches and under utilities or utility services crossing the trench, provide trench backfill using select fill placed in uniform layers not greater than 9 inches in loose thickness and thoroughly compacted in place with equipment as specified above. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D1557.

5. Depth of Placement - Undeveloped Areas: In undeveloped areas and where select fill material or hand-placed backfill are not specified or required, place suitable job-excavated material or other approved backfill in lifts not exceeding 12 inches in loose thickness. When the trench is full, consolidate the backfill by jetting, spading, tamping or puddling to ensure complete

filling of the excavation. Mound the top of the trench approximately 12 inches to allow for consolidation of backfill.

6. Backfill trenches in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance. Do not allow backfilling material from a bucket to fall directly on a structure or pipe and, in all cases, lower the bucket so that the shock of falling earth will not cause damage.

7. Break up lumps and distribute any stones, pieces of crushed rock or lumps which cannot readily be broken up, throughout the mass so that all interstices are solidly filled with fine material.

8. Retain backfill in trenches by temporary bulkheads only and remove them as the backfilling progresses. Do not make bulkheads of stone.

9. Do not cover sewers, drains, basin connections, ends of sewers and branches until the Engineer orders or gives permission to backfill.

10. After completion of backfilling in City streets, remove all surplus material, and regrade and leave free, clear, and in good order all roadways and sidewalks. Deposit and compact a temporary surface of asphalt, or other equivalent and suitable material to a depth of six inches on all backfilled areas where ordered by the Engineer in writing. Until areas are restored to their original condition, maintain the surface of the temporary pavement in good and safe condition and promptly fill all depressions caused by settlement of the backfill with the temporary surfacing materials and compact the same. Wet the temporary surface by spraying with water when necessary to prevent a dust nuisance.

H. Structure Backfill

1. Backfill excavations as soon as, in the opinion of the Engineer, it can be done without injury to the concrete or structures.

2. Use select fill underneath all structures, and adjacent to structures where pipes, connections, electrical ducts and structural foundations are to be located within this fill. Use select fill beneath all pavements, walkways, and railroad tracks, and extend to the bottom of pavement base course or ballast.

   a. Place select fill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.

   b. Compact select fill to not less than 95 percent of the maximum dry density as determined by ASTM D1557.

3. .Use of common granular fill adjacent to structures in all areas not specified above, unless otherwise shown or specified. Select fill may be used in place of common granular fill at no additional cost.

   a. Extend such backfill from the bottom of the excavation or top of bedding to the underside of the lawn mix for seeded, sodded or

hydroseeded areas, the top of previously existing ground surface or to such other grades as may be shown or required.

b. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.

c. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D1557.

4. In unpaved areas adjacent to structures, for the top 1 foot of fill directly under the lawn mix, use cohesive backfill conforming to Article 2.02.G.3, placed in 6-inch lifts. The cohesive backfill shall extend to the limits of the excavated area. Compact to not less than 90 percent of the maximum dry density as determined by ASTM D1557.

5. When sheeting is withdrawn, solidly fill all cavities in or adjoining the trench or other excavation. When sheeting is left in place, solidly fill all cavities behind such sheeting.

I. Finish Grading

1. Perform finish grading in accordance with the completed contour elevations and grades shown on the Contract Drawings and blend into conformation with remaining natural ground surfaces.

a. Leave all finished grading surfaces smooth and firm to drain. Areas shall be finished to the degree obtainable by either blade or scraper operations and suitable for application of topsoil.

b. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.

c. Areas which are anticipated to be undisturbed for a period of more than 14 days shall be stabilized in accordance with the NYSDEC Blue Book, Section 31 25 10 – Dust Soil Erosion and Sediment Control, and Section 32 90 00 – Planting.

2. Grade outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

3.03 FIELD TESTING / QUALITY CONTROL

A. Sampling and Testing of Select and Common Backfill:

1. Provide sampling, testing, and laboratory methods in accordance with ASTM D1556 or other method as determined by the Engineer for select fill and common fill.

2. Subject all backfill to these tests to the satisfaction of the Engineer. These tests shall be the basis for acceptance or rejection by the Engineer of the

compaction. Failure to achieve the specified densities shall require the Contractor to recompact or remove the material as required.

B. Correction of Work:

1. Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating or sprinkling as needed and recompaction in place prior to placement of a new lift. The Contractor shall, if necessary, increase the compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the lift thickness. The Contractor shall adjust the moisture content of the soil to bring it to the optimum range by drying or adding water, as required.

2. Correct any depression which may develop from settlement in backfilled areas within one year after the work is fully completed. Provide, as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 31 25 10 - DUST, SOIL EROSION AND SEDIMENT CONTROL
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, tools, equipment, and incidentals required to assure adequate environmental protection including implementation of all erosion and sediment control measures and maintenance of storage areas as directed by the Engineer.

B. The Contractor shall provide an Erosion and Sediment Control Plan (E&SCP) that establishes methods and procedures to prevent migration of contaminated stormwater and sediment and to prevent erosion of features of the Work.

C. The Contractor shall minimize erosion and prevent discharge of sediment to surface water features, watercourses, drainage systems, public streets or private property from construction activities. The Contractor shall provide methods to prevent construction activities from generating contaminated stormwater runoff. Methods of constructing berms and dikes to direct clean stormwater runoff around the work area to the local drainage system shall be included.

D. The Contractor shall comply with all Federal, State, or local laws, codes, ordinances, and regulations which govern the control of sediment, erosion, and stormwater during construction activities.

E. The Contractor shall provide Best Management Practices (BMPs), including, but not limited to silt fences, straw bales, diversion dikes, swales, sedimentation basins/traps, truck wash areas/decontamination stations, stabilized construction entrances and/or other means as a temporary structural practice to minimize erosion and sediment runoff.

F. The Contractor shall implement dust, erosion, and sediment control and stormwater pollution prevention in accordance with the requirements of the current NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity, and, in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP) for this contract prepared by the Engineer.

G. The approved SWPPP for this contract will be made available to the Contractor upon request during the bidding process. Proposed modifications to the approved SWPPP shall be in accordance with the requirements of this Section.

H. The Contractor shall control dust caused by operation and movement of vehicles and equipment in accordance with the latest DEP and OSHA standards, and all other applicable Federal, State and local regulations.

I. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2

1.05 Description 3
1.06 Quality Assurance 6
1.07 Submittals 7
1.08 Delivery, Storage, and Handling 10
1.09 Spare Parts, Special Tools, and Supplies 10
1.10 Warranty 10
PART 2 PRODUCTS 10
2.01 Manufacturers 10
2.02 Materials / Equipment 10
2.03 Fabrication / Assembling / Finishes 11
2.04 Source Quality Control / Shop Tests 11
PART 3 EXECUTION.....11
3.01 Examination / Preparation 11
3.02 Implementation 11
3.03 Field Testing / Quality Control 13
3.04 Startup / Demonstration 13
3.05 Adjusting / Protection / Cleanup.....13

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 74 20 – Construction Waste Management

B. Section 02 24 20 - Soil Sampling and Analysis

C. Section 31 10 10 - Site Clearing

D. Section 31 23 19 - Dewatering

E. Section 31 23 16 - Excavation

1.04 REFERENCES

A. Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-25-001, or latest version)

2. New York City Watershed Regulations (April 4, 2010, or latest version)

3. New York State Standards and Specifications for Erosion and Sediment Control (aka “Blue Book”) (NYSDEC, November 2016, or latest version)

4. New York State Stormwater Management Design Manual (latest version)

5. New York State Department of Environmental Conservation (NYSDEC)

a. 6NYCRR Part 361-4 – Mulch Processing Facilities.

1.05 DESCRIPTION

A. Definitions

1. Best Management Practices: Physical, structural, and/or managerial practices that, when used singly or in combination, prevent or reduce pollution of water, and have been approved by DEP or NYSDEC.

2. Commencement of Construction: The initial disturbance of soils associated with clearing, grading or excavation activities; or other construction related activities that disturb or expose soils such as demolition, stockpiling of fill material, and the initial installation of erosion and sediment control practices.

3. Erosion: The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as geological creep, detachment, movement of soil or rock fragments by water, wind, ice, or gravity.

4. Erosion/Sediment Control: Any temporary or permanent measures taken to reduce erosion, control siltation and sediment, and ensure that sediment-laden water does not leave the site.

5. Final Stabilization: All soil-disturbing activities at the site have been completed and uniform, perennial vegetative cover with the density of eighty (80) percent has been established or equivalent stabilization measures (such as the use of mulches or geo-textiles) have been employed on all unpaved areas and areas not covered by permanent structures, concrete or pavement.

   a. Vegetative cover stabilization shall employ a Meadow Mix as per Section 32 90 00 – Planting, unless otherwise noted on the Contract Drawings.

6. Receiving Waters: Bodies of water or surface water systems receiving water from upstream manmade (or natural) streams

7. Sediment: Fragmented material that originates from weathering and erosion of rocks and unsolicited deposits, and is transported by, suspended in, or deposited in water.

B. Environmental Requirements

1. Soil Stabilization: The stabilization practices to be implemented shall include one or a combination of the following: temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control mats, protection of trees and shrubs, preservation of mature vegetation. Protection of trees shall be in accordance with Section 31 10 10 – Site Clearing. Stabilization practices shall be implemented as approved by the Engineer. Seeding and planting shall be in accordance with Section 32 90 00-Planting. Temporary seeding shall utilize methods and materials

as specified in Section 32 90 00 – Planting and the Contract Drawings. The Contractor shall record the dates when the major grading activities occur (i.e. clearing and grubbing, excavation, embankment and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs below, stabilization practices shall be initiated as soon as practicable, but no more than fourteen (14) days after construction activities have temporarily or permanently ceased.

a. Unsuitable Conditions: Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather. Stabilization practices shall be initiated as soon as practicable after conditions become suitable.

b. Non-Winter month Temporary Inactivity Less than 14 Days: Where construction activity will resume on a portion of the Site within 14 days after it temporarily ceases, no stabilization practices will be required.

c. Winter months Temporary Inactivity Less than 3 days: In winter months, where construction activity will resume on a portion of the site within 3 days after it temporarily ceases, no stabilization practices will be required.

2. Erosion and Sediment Control: Erosion and Sediment control BMPs shall be operational at all times during the Work, specifically during excavation, backfilling and restoration, and decontamination operations. The sediment and erosion control system shall be capable of handling stormwater during construction. Damage to excavation slopes and the migration of contaminated soil to downstream areas resulting from storm events shall be repaired or remediated by the Contractor, at the Contractor's expense.

3. Stormwater: At no time shall the Contractor allow stormwater runoff from soil excavation/stockpiling operations, or effluent from decontamination operations to migrate off to contaminate soils in other areas or percolate into the groundwater. The Engineer will monitor any overflow or leakage that occurs and may at his discretion require the Contractor to perform soil sampling within all areas affected by such overflow. Any soils that have been contaminated by such overflow shall be removed, treated, and disposed of by the Contractor at no additional cost to DEP. All sampling and analyses of soils required to determine the contamination or remediation of these soils shall be performed in accordance with Section 02 24 20 – Soil Sampling and Analysis.

4. Disposal of Water: Water collected from decontamination areas and dewatering operations shall be handled in accordance with Section 31 23 19 - Dewatering.

5. Concrete Washout Debris: In accordance with NYC Local Law 70 of 2011 concrete washout shall not be allowed to enter the sewer. Concrete washout muck and debris shall be removed and adequately disposed by the Contractor at no additional cost to DEP.

C. Project Conditions

1. Existing Work: All BMPS (e.g., silt fences, straw bales, swales, sumps, pumps, piping) and other sediment/stormwater controls shall be installed such that other aspects of the Work are not adversely impacted or endangered. All installations shall be subject to the approval of the Engineer.

2. Dust Control: The Contractor shall be responsible for controlling visible dust caused by Work operations and the moving of vehicles and equipment. Dust control shall be implemented when soils are exposed, before, during and after Work activity ceases. Dust control will also be required on the weekends. The Contractor shall utilize the application of water or other methods, subject to the Engineer's approval, when visible dust is present on-site, in accordance with the Health and Safety Plan. The use of chemicals for dust control, including calcium chloride, will not be permitted.

   a. All excavation, loading and transport of materials shall minimize the formation of dust and shall conform to Section 31 23 16 - Excavation. To prevent dust generation, application of water to roadways and active work areas shall be utilized as required. The Contractor's operations shall include air monitoring and dust minimization measures, consistent with the Health and Safety Plan (HASP) Specifications.

3. Silt and Sediment Disposal: All silt and sediment which accumulates behind any BMPs used on the site (i.e., straw bale berms or silt fences) shall be removed and disposed of off-site in accordance with all applicable Federal, State, and local regulations.

D. Installation and Maintenance

1. All installation of erosion and sediment control BMPs must be consistent with the most current version of the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, and the New York State Stormwater Management Design Manual. Where erosion and sediment control practices are not designed in conformance with these technical standards, the Contractor must submit modified practices as part of the Contractor's Erosion and Sediment Control Plan, demonstrate equivalence to the technical standard, obtain the Engineer's approval and update the Project SWPPP accordingly.

2. Maintenance: The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition at all times consistent

with the most current version of the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, and the New York State Stormwater Management Design Manual.

1.06 QUALITY ASSURANCE

A. Permits and Regulations:

1. The Contractor shall obtain all necessary permits and be responsible for implementing the terms and requirements of these permits as needed and for payment of all fees.

2. The Contractor shall handle all material in compliance with applicable requirements of OSHA and other governing authorities having jurisdiction.

3. Certifications. The Contractor must sign a copy of the certification statements below, as provided in GP-0-25-001 (or certifications in latest version), before undertaking any construction activity at the site identified in the SWPPP. All certifications must be included in the SWPPP.

a. “I hereby certify that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the NYCDEP must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System ("SPDES") General Permit for Stormwater Discharges from Construction Activity (GP-0-25-001, or latest version) and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.”

b. The certification statements must include the name and title of the person providing the signature, address and telephone number of the contracting firm, the address of the site, and the date the certification is made. The certification must be signed by an authorized representative of the firm.

4. Inspections.

a. Maintenance Inspections: A trained contractor shall inspect the erosion and sediment control practices and pollution measures being implemented within the active work area daily to ensure that they are always being maintained in effective operating conditions. If deficiencies are identified, the Contractor shall begin implementing corrective actions within one business day and shall complete the corrective actions in a reasonable time frame.

b. Qualified Inspector Site Inspections: The Contractor shall coordinate inspections with the Construction Manager’s Qualified

Inspector. Qualified Inspector Site inspections are conducted a minimum of twice every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days. The Contractor shall begin implementing any corrective actions identified by the Qualified Inspector within one business day and shall complete the corrective actions in a reasonable time frame.

5. Stabilization. The contractor shall initiate stabilization measures as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased.

6. The SWPPP shall be kept current on file at the construction site for review by a NYSDEC inspector. If there is a significant change in construction which may have a significant effect on the potential for the discharge of pollutants to surface waters of the State and which has not otherwise been addressed in the SWPPP, it would require that the SWPPP be updated to reflect those required changes. The SWPPP would also require an amendment if the SWPPP proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified in the SWPPP or achieving the general objectives of controlling pollutants in stormwater discharges from permitted construction activity. Additionally, the SWPPP shall be amended to identify any new subcontractor and their associated responsibilities.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and other documentation, required to show conformance to the requirements of the Contract Drawings, for the approval to the Engineer. Shop Drawings shall show details of the Sediment and Stormwater Control System. The Submittals shall include, but not limited to the following:

1. Plan locations of all components of the Sediment/Stormwater Control System.

2. Details of all applicable BMPs (e.g., silt fence, diversion dike, straw bale berm, decontamination stations, etc.).

3. All of the planned components of the Erosion and Sediment Control Plan, as detailed below in Paragraph B.

4. All components of the SWPPP to be constructed on site, as detailed in Paragraph C below.

5. The Contractor shall submit manufacturer's descriptive literature and installation instructions for stockpile liner and cover material as specified in Paragraph 2.01.B and Part 3.02.

B. Erosion and Sediment Control Plan (E&SCP): The Contractor shall develop and submit to the Engineer for approval, prior to commencement of construction activities, an E&SCP. The E&SCP shall address schedules and measures that will be taken to prevent migration of contaminated stormwater/sediment, and to prevent

erosion of features of the Work. The E&SCP shall include the following at a minimum:

1. Measures to capture and mitigate stormwater runoff from active, disturbed areas.
2. Provisions for silt fences and other measures to limit migration of sediments.
3. Provisions for straw bale berms and silt fences or other measures to prevent contaminant and sediment migration.
4. Diversion of stormwater: The Contractor shall include provisions for controlling stormwater runoff in and around excavation areas.
5. Soil Storage Area: All details of temporary soil storage to be implemented as specified in this section.
6. Soil Stabilization Practices: All details of soil stabilization practices to be implemented, as specified in this section.
7. Provisions for all other applicable Best Management Practices.

C. The Contractor shall adopt the approved SWPPP prepared by the Engineer for this Contract. If the Contractor proposes to modify the approved SWPPP, the Contractor shall develop and submit to the Engineer for approval the modified SWPPP in accordance with the requirements of the current NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity. The modified SWPPP shall be developed and submitted to the Engineer for approval prior to the initiation of construction activities. The modified SWPPP must be in compliance with the requirements of this Section in all respects. The Contractor shall bear sole responsibility for all permitting requirements of, and coordination with, the governing authorities having jurisdiction, as well as for any costs and delays resulting from the modification(s).

The SWPPP shall include the following at a minimum:

1. Provide background information about the scope of the Project, including the location, type and size of Project;
2. Provide a site map for the Project, including a general location map. The site map should show the total site area; all improvements; areas of disturbance; areas that will not be disturbed; existing vegetation; on-site and adjacent off-site surface water(s), wetlands and drainage patterns that could be affected by the construction activity; existing and final slopes; locations of off-site material, waste, borrow or equipment storage areas; and location(s) of the stormwater discharge(s);
3. Provide a map and a description of the soil(s) present at the Site;
4. Provide a Construction Phasing Plan describing the intended sequence of construction activities, including clearing and grubbing, excavation and grading, utility and infrastructure installation and any other activity at the site that results in soil disturbance. Consistent with the NYSDEC SPDES

General Permit for Stormwater Discharges from Construction Activity (GP-0-25-001 or latest version), there shall not be more than five (5) acres of disturbed soil at any one time without prior written approval from the NYCDEP and/or NYSDEC;

5. Provide a description of the pollution prevention measures that will be used to control litter, construction chemicals and construction debris from becoming a pollutant source in the stormwater discharges;

6. Provide a description of construction and waste materials expected to be stored on-site with updates as appropriate, and a description of controls to reduce pollutants from these materials including storage practices to minimize exposure of the materials to stormwater, and spill prevention response;

7. Describe the temporary and permanent structural and vegetative measures to be used for soil stabilization, runoff control and sediment control for each stage of the Project from initial land clearing and grubbing to Project Closeout;

8. Identify and show on a site map the specific location(s), size(s), and length(s) of each erosion and sediment control practice;

9. Provide the dimensions, material specifications, and installation details for all erosion and sediment control practices, including the siting and sizing of any temporary sediment basins;

10. Identify temporary practices that will be converted to permanent control measures;

11. Provide an implementation schedule for staging temporary erosion and sediment control practices, including the timing of initial placement and the placement and the duration that each practice should remain in place;

12. Provide a maintenance schedule to ensure continuous and effective operation of the erosion and sediment control practices;

13. Provide the name(s) of the receiving water(s);

14. Provide a delineation of SWPPP implementation responsibilities for each part of the Site;

15. Provide a description of structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable; and

16. Provide any existing data that describes the stormwater runoff characteristics at the Site.

D. Inspection Reports: The Contractor shall conduct inspections and submit inspection reports consistent with requirements of the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-25-001 or latest version) including:

1. Site inspections shall be conducted by the Qualified Inspector.
2. Site inspections are conducted a minimum of once every seven (7) calendar days and twice every seven (7) calendar days for sites with greater than 5 acres of soil disturbance. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.
3. Inspection reports shall be maintained in a logbook at the site with SWPPP and other required documentation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall store, handle, and remove material and equipment consistent with requirements of the SWPPP and NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (Permit No. GP-0-25-001) or latest version.

B. Removal of all waste shall be in accordance with the requirements of Section 01 74 20 – Construction Waste Management.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Materials

1. Where erosion and sediment control practices are not designed in conformance with these technical standards, the Contractor must submit modified practices as part of the Contractor's Erosion and Sediment Control Plan, demonstrate equivalence to the technical standard, obtain the Engineer's approval and update the project SWPPP accordingly.
2. Stockpile cover and liner fabric shall be a composite structure of fiber-reinforced polyethylene (RPE) fabric (minimum 20-mils). The fabric shall be inert to biological degradation and naturally encountered chemicals, alkalis and acids. Its permeability coefficient shall be less than 10^{-3} cm/sec.
3. Compost shall meet the following requirements:
    a. Be well decomposed, aerobically composted at least 3 months, with no objectionable odors;
    b. Be weed-free, organic matter, containing less than 1%, by dry weight, of man-made foreign materials; and

c. Be in accordance with the Blue Book Table 5.2 - Compost Standards Table, except that the 100% of the material shall pass through the 1/2% sieve.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Stockpiling

1. Cover and Liner Requirements

a. Soil Stockpiles: Stockpiles of excavated soil to be used for backfilling on-site under the NYSDEC Pre-Determined or Case-Specific BUD, or stockpiles of other soil mixes being brought on-Site for landscaping purposes, shall be stored as follows:

1) Contaminated Soil: Stockpiles of excavated soil that are known to be or potentially could be contaminated (pending analysis), shall be lined on the bottom and covered with an impermeable, RFP fabric, as specified in 2.02.A above.

2) Uncontaminated Soil: Stockpiles of excavated uncontaminated soil shall have a cover only; a bottom liner is not required. The cover fabric shall be as specified in 2.01.A above.

3) Delaware Aerator Topsoil Pile: Delaware Aerator Topsoil pile, as shown in contract drawings, shall be stabilized in accordance with the NYSDEC Blue Book; a bottom liner is not required.

b. Demolition Waste Stockpiles: Stockpiles of demolition waste that are to be recycled (on-Site or off-Site) or disposed of at a sanitary landfill shall be stored as follows:

1) Contaminated Demolition Waste: Stockpiles of demolition waste that are known to be or potentially could be contaminated (pending analysis), shall be lined on the bottom and covered with an impermeable, RFP fabric, as specified in 2.01.A above.

2) Uncontaminated Demolition Waste: Stockpiles of uncontaminated demolition waste shall have a cover only; a

bottom liner is not required. The cover fabric shall be as specified in 2.01.A above.

c. Stockpiles of materials classified as contaminated, hazardous waste shall be stored with a cover and liner as specified above for contaminated soil or contaminated demolition waste, and transported off-site promptly in DOT-approved hazardous waste shipping containers. Temporary hazardous waste storage areas shall comply with and the requirements of the Contract and applicable Federal, State, and local regulations.

d. All stockpiles shall be covered during non-working hours and during periods of no construction activity. The terminal edges of the fabric cover panels shall be secured to prevent uplift by wind.

2. Stockpile Areas and Placement

a. Stockpiling of excavated materials will be permitted on-Site within areas as designated on the Contract Drawings for construction staging, or as directed by the Engineer. All stockpiling areas on-Site must be approved by the Engineer in advance.

b. The Contractor shall make his or her own arrangements to provide additional stockpiling area on-site or off-site, if required, for excavated material at no additional cost to DEP. Additional stockpiling areas whether on-site or off-site shall be approved by the Engineer.

c. Stockpiles of excavated material to be used for backfilling on-Site under the NYSDEC Pre-Determined or Case-Specific BUD shall be so piled and placed as not to encumber sidewalks or roadways, or wash away or obstruct the free flow of surface or drainage water. Stockpiles shall be suitably bermed for run-off containment of any water that drains from the soils.

d. Stockpiles shall not be placed closer to the edge of an excavation than a distance equal to 1-1/2 times the depth of the excavation, unless the excavation is in rock or the sides of the excavation have been sloped or sheeted and shored to withstand the lateral forces imposed by such superimposed loads.

B. The Contractor shall provide winter stabilization in accordance with Section 2.38 of the NYS Standards and Specifications for Erosion and Sediment Control (Blue Book). The winter stabilization standards apply to all construction activities involved with ongoing land disturbances and exposure between November 15th to the following April 1st. The Contractor shall provide the following:

1. Snow Management Plan

2. 25 ft. perimeter buffers

3. Tall marker stakes for silt fence

4. 2 rows of silt fence if within 100ft. of a waterbody
5. Clear flow paths to drainage structures
6. Soil stockpiles shall be stabilized
7. Soil stabilization performed daily
8. Provide 2x normal mulching rate

C. The Contractor shall provide soil restoration in accordance with Table 4.6 Soil Restoration Requirements of the Blue Book to the subgrade soil, prior to placement of topsoil or planting materials. The soil restoration standard shall be applied to areas where heavy construction traffic has occurred, or as specified by the Contract Drawings prior to final stabilization. The Contractor shall:

1. Apply 3 inches compost, as specified in Section 2.02.A.4 above, over the subgrade soil.
2. Till compost into the subgrade to a depth of at least 12 inches using a cat-mounted ripper, tractor mounted disc, or tiller, to mix and circulate air and compost into the subsoil.
    a. No light-duty chisel plows shall be used.
3. All stone or rock material greater than four inches shall be removed from the subgrade.

3.03 FIELD TESTING / QUALITY CONTROL

A. Inspection of soil and material stockpiles shall be done daily to ensure the integrity of the cover and liner is maintained.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. The Contractor shall clean the site and equipment consistent with requirements of the SWPPP and the current New York State Standards and Specifications for Erosion and Sediment Control, Section 01 74 17 – Cleaning and Site Maintenance and Section 31 10 10 – Site Clearing.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 31 40 00 – SHORING AND UNDERPINNING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all equipment, labor, materials and incidental items necessary to perform shoring and underpinning as specified herein and shown on the Contract Drawings.

B. Shoring and underpinning includes, but is not limited to:

1. Temporary and permanent supports for existing structures or structural elements, duct banks, pipes, or other utilities.

2. Monitoring of movements.

C. The Contractor shall be solely responsible for maintaining, at all times, the safety, stability and integrity of every structure and facility regardless of location, which might be affected by his Work.

D. The Contractor shall be responsible for any damage due to his Work and for any corrective action or repairs needed to restore any damaged structure or facility to its condition prior to the start of Work.

E. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Implementation	7
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Requirements from the following sections also apply to the Section:

1.	Section 03 30 00	-	Cast-in-Place Concrete
2.	Section 03 60 00	-	Grouting
3.	Section 05 05 13.01	-	Galvanizing
4.	Section 05 12 00	-	Structural Steel Framing
5.	Section 31 23 16	-	Excavation
6.	Section 31 23 23	-	Fill

1.04 REFERENCES

A. Definitions

1. Shoring and underpinning provides the means to transfer the structure load from an existing foundation to a new foundation. Shoring and underpinning shall be designed to furnish a safe and permanent independent support for each structure, using such methods as specific conditions require.

B. Reference Standards:

1.	ASTM A36	-	Carbon Structural Steel
2.	ASTM A108	-	Steel Bars, Carbon, Cold Finished, Standard Quality
3.	ASTM A153	-	Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A307	-	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5.	ANSI/AWS D1.1	-	Structural Welding Code

6. AWPA T1 - Use Category System: Processing and Treatment Standard
7. AWPA U1- Use Category System: User Specification for Treated Wood
8. New York City Building Code (NYCBC)

1.05 DESCRIPTION

A. Contractor’s Responsibilities

1. The Contractor is solely responsible for the safety, stability and integrity of all structures affected by Work. The Contractor shall, at his own expense,

provide the services of qualified Professional Engineers registered in the State of New York for the Work as specified herein.

2. The Contractor shall consult the records of adjacent construction and of existing utilities and their connections, and shall perform a field condition survey on all affected structures and document actual dimensions and existing physical conditions.

   a. The start of shoring and underpinning shall be contingent on the results of the investigation of existing conditions.

   b. The Contractor shall be cognizant of conditions and limitations which may influence the Work and shall take proper measurements for these conditions.

3. The Contractor shall not proceed with the Work until unsatisfactory conditions, as determined by the Contractor or the Engineer, have been corrected in a manner acceptable to the Engineer.

4. The Contractor shall protect as required all public and private properties adjacent to the Work. The Contractor shall at his own expense make repairs to damaged property necessitated by reasons of, or occurring in the course of, operations under this Contract, to the complete satisfaction of the Engineer and the property owner (City or private) of the damaged property.

5. The Contractor shall be responsible for providing shoring and underpinning as may be needed for prevention of movement and to protect affected structures.

6. The Contractor shall obtain all necessary permits for shoring and underpinning structures and any required reconstruction.

B. Structures Examination

1. Prior to starting the Work, the Contractor, the DEP and the Engineer shall make a joint inspection of the existing structures to examine and document their present conditions.

2. Photographs shall be taken by the Contractor to record any exterior or interior conditions of a structure that may become the subject of damage claims.

3. The Contractor shall prepare a report for each structure documenting all pre-existing conditions, verified by the photographs, and signed by the personnel of the Contractor, the DEP and the Engineer participating in the investigation.

4. The structures to be examined under this Contract are as specified herein or shown on the Contract Drawings.

1.06 QUALITY ASSURANCE

A. Qualifications

1. The shoring and underpinning Work shall be performed by the Contractor or a Subcontractor specializing in and having experience installing, maintaining and monitoring shoring and underpinning systems in similar circumstances for at least five (5) years.

2. Shoring and underpinning systems shall be designed by a Professional Engineer registered in the State of New York, having experience in successfully designing systems for similar conditions.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Shop Drawings shall include, but not be limited to:

1. Detailed drawings for the proposed shoring and underpinning work, including plans, elevations, sections and details.

a. Proposed construction sequence, procedures and schedule including arrangement and method of assembly of the proposed shoring and underpinning system. Provide procedures for preloading of system, if applicable.

b. The drawings showing all of the above information, including calculations, shall be prepared by a qualified Registered Professional Engineer and shall bear his signature and seal.

2. Description of proposed equipment including data for gages and jack calibration certified by an accepted testing agency.

3. Anticipated construction equipment loads.

4. Product data for all materials.

B. The Contractor shall also submit:

1. Detailed drawings indicating reference point locations of existing structures or utilities.

2. A preconstruction survey report establishing the condition of all adjacent structures.

3. Structures monitoring program including schedule and proposed instruments.

4. Complete procedures for detection of vertical or horizontal movement in existing structures.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Timber:

1. Timber shall be Douglas Fir or Southern Pine, Dense No. 2 with a minimum allowable bending stress of 1,200 psi. Timber in contact with the ground shall be treated in accordance with the following requirements:

a. Wood products shall be treated with waterborne wood preservatives listed in Section 4 of AWPA Standards U1, excluding those which contain arsenic and/or chromium.

b. Pressure treatment of wood products shall conform to the requirements of AWPA Standards U1 and T1.

c. Retention of preservatives as prescribed in AWPA Standard U1 for the following Use Categories (material conforming to a higher AWPA Use Category may be specified):

1) UC4A: General purpose soil or fresh water contact - heavy duty above ground.

2) UC4B: Heavy duty soil or fresh water contact - critical or difficult to replace components.

3) UC4C: Extreme duty soil or fresh water contact - critical structural components.

d. Boron-based preservatives:

1) Impregnate lumber with preservative treatment conforming to AWPA Standard U1.

B. Steel:

1. All steel for rakers, braces, wales, struts, plates, edges and shims shall conform to ASTM A36 and the requirements of Section 05 12 00 - Structural Steel Framing.

C. Hardware:

1. Bolts and nuts shall be heavy hex head conforming to ASTM A307.

2. Expansion anchors shall be carbon steel conforming to ASTM A108, and shall be galvanized in accordance with ASTM A153 and Section 05 05 13.01 - Galvanizing.

3. Headed studs shall be carbon steel conforming to ASTM A108.

D. Concrete:

1. Cement, aggregate, reinforcing steel and mixes shall be as specified in Section 03 30 00 - Cast-in-Place Concrete.
2. Mixes shall conform to the following requirements:
    a. Concrete piers shall conform to Class 45F with 3/4-inch maximum aggregate size.
    b. Subgrade concrete workmat shall conform to Class 25.
    c. Drypack grout shall conform to Section 03 60 00 – Grouting.
    d. Backpacking shall be a mixture of one bag Portland cement and one cubic yard of concrete sand.

E. Earthwork:

1. Earthwork shall conform to Section 31 23 16 - Excavation and Section 31 23 23 - Fill.

F. Miscellaneous:

1. Jacks, pumps and gages shall have certified calibration curves less than one (1) year old.
2. Wedges shall be forged steel or white oak.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Prior to the start of shoring and underpinning Work, and where shown on the Contract Drawings or specified here in, the Contractor shall establish a system of vertical movement monitoring (settlement) and lateral movement monitoring (offset reading points) on the potentially affected structures or utilities and on elements of the shoring and underpinning system. Baseline readings shall be made three (3) days prior to the start of the Work.

B. The Contractor shall provide a contingency shoring plan or alternate procedures to be implemented if excessive movement, as defined in the Contract Drawings and specified herein, is evident. The Contractor shall keep on hand materials and equipment necessary to implement the contingency shoring and underpinning plan.

C. The Contractor shall locate existing utilities in the work area and determine if they interfere with the proposed Work and notify the Engineer immediately if interference is found. Work shall proceed with caution in areas of known utility facilities.

3.02 IMPLEMENTATION

A. Structures Monitoring

1. A monitoring program shall be prepared by a qualified Professional Engineer licensed and registered in the State of New York and shall bear his or her signature and seal.

2. The Contractor shall clearly identify benchmarks and record existing elevations. Datum level used to establish benchmark elevations shall be located in an area that will not be disturbed by movement resulting from shoring and underpinning operations.

3. Devices for determining movements shall be firmly affixed and spaced as required to adequately detect any movement. Devices shall be checked daily during shoring and underpinning installation and weekly after installation is complete.

4. The Contractor shall maintain a log of movement of monitoring readings for comparison with original recorded positions, and shall promptly notify the Engineer if movement occurs or if cracking or other damage is evident.

B. Performance of the Work

1. Excavation:

a. Subgrade of all underpinning piers, heelblocks, deadmen, footings and walls will be inspected and no concrete shall be placed until approval is granted by the Engineer. Concrete should be placed within eighteen (18) hours of attaining approved undisturbed subgrade or the Contractor may pour a lean concrete workmat to prevent disturbance of the subgrade.

b. Excavations shall be limited to the lines, grades and elevations shown on the Contract Drawings. The Contractor shall immediately backfill and compact over excavated areas.

c. All pit excavations shall be protected with temporary covers.

d. Excavated material shall not be stockpiled adjacent to pits or existing walls.

e. If unstable material is encountered during excavation, the Contractor shall take suitable measures to contain it in place and prevent ground displacement.

2. Lagging:

a. Lagging shall be installed true to line and location in accordance with the Contract Drawings. Excavation for the installation of lagging shall be carefully performed to minimize voids behind the timber.

b. Depth of excavation below installed breastboards shall not exceed twenty-four (24) inches. Boards shall be separated sufficiently as

they are installed to permit back-packing behind the breastboards with a dry sand-cement mixture to eliminate any voids resulting from the excavation.

c. If the soil is over excavated by more than six (6) inches behind the lagging and the over excavation extends more than one (1) foot in any direction in the plane of the wall, then grout shall be used for back-packing of the over excavation.

3. Concreting:

a. Where applicable, the underside of the existing footing or wall above shall be cleaned. Any standing water shall be removed from pits or excavations unless a tremie operation is intended.

b. Concrete shall be placed and cured as specified in Section 03 30 00 - Cast-in-Place Concrete. Where applicable, pits shall be filled with concrete to approximately three (3) inches below the bottom of the existing footing or wall above.

4. Drypacking:

a. Drypack shall be placed between new concrete and existing surfaces after the new concrete has cured for a minimum of twenty-four (24) hours.

b. Surfaces shall be moistened prior to drypacking. Drypacking shall be rammed or rodded into place to completely fill the intended space, removing all voids.

5. Steel Wales, Struts, Braces and Rakers:

a. Wales and braces shall be shimmed to provide continuous bearing between the steel and existing surfaces. If steel shims are used, they shall be welded in place; timber shims shall be nailed in place.

b. Rakers shall be wedged to a snug fit. If steel wedges are used, they shall be welded in place; timber wedges shall be nailed in place.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. The Contractor shall exercise care throughout the progress of the Work to avoid damage to the existing work remaining in place, and to adjacent structures, and in the event of any such damage, the Contractor shall replace or repair such affected work to the satisfaction of the Engineer and without additional cost to DEP.

B. Removal of Shoring and Underpinning

1. The Contractor shall maintain shoring and underpinning until structural elements are rebraced and resupported and permanent construction is able to withstand all loads.
2. When it is determined by the Contractor that the shoring and underpinning is no longer required, the Contractor shall obtain the Engineer's concurrence to proceed with its removal.
3. Any damages to the structures shall be the sole responsibility of the Contractor and he shall bear the entire cost of correcting any such damage.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. This Work shall consist of constructing micropiles as shown on the Contract Drawings and approved working drawings and as specified herein. The Contractor is responsible for furnishing of all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for construction.

2. The Contractor shall select the micropile type, size, pile top attachment, and installation means and methods; estimate the ground-grout bond value; and determine the required grout bond length and final micropile diameter. The Contractor shall design and install micropiles that will develop the load capacities indicated on the Contract Documents. The micropile load capacities shall be confirmed by verification and proof load testing as required and must meet the test acceptance criteria specified herein.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	8
1.09	Spare Parts, Special Tools, and Supplies	8
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Implementation	9
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

1.02 PAYMENT

A. Measurement: The quantities of micropiling per unit to be measured for payment of the unit price bid will be the actual number of piles drilled or installed and left in place in conformity with the Contract.

B. Payment for all micropiling work will be as specified in Section 01 27 00 – Measurement and Payment and will be made at the unit prices bid for piling, verification testing, proof testing, and micropile length adjustment. The unit price bid shall include the cost of furnishing all labor, materials, equipment and incidentals necessary to complete the work specified in this Section.

C. No Separate Payment:

1. No separate payment will be made for inspection of piles, test piles, removing or replacing damaged piles, piles installed for the temporary use or for the convenience of the Contractor, and pile surveys and related drawings. The costs thereof shall be included in the unit prices bid for piles.

2. No separate payment will be made for excavating for pile installation, replacing unsuitable materials; for furnishing, placing and compacting fill and backfill material; or for seismic monitoring; the costs thereof shall be included in the lump sum price bid for the Contract.

1.03 RELATED SECTIONS

A. Requirements from the following sections also apply to the Section:

1.	Section 01 33 00	-	Submittal Procedures
2.	Section 03 21 00	-	Reinforcing Steel
3.	Section 03 30 00	-	Cast-in-Place Concrete
4.	Section 31 09 16.20	-	Pile Load

1.04 REFERENCES

A. General: Comply with the provisions of the latest version of the publications listed below except as otherwise shown or specified.

B. Geotechnical Reports prepared by AECOM as follows:

1. “ “Based on the Ductile Iron Pipe Research Association’s (DIPRA) 10-Point System and the results presented in **Tables 3 and 4**, the soils at the site are considered to be non-corrosive”, dated January 2025

2.

C. American Concrete Institute (ACI):

1. ACI 318: Building Code Requirements for Structural Concrete

D. New York City Building Code (NYCBC)

E. American Welding Society (AWS):

1. AWS D1.1: Structural Welding Code – Steel

2. AWS D1.4: Structural Welding Code – Reinforcing Steel

F. American Society for Testing and Materials (ASTM):

1. ASTM A615/A615M-09b, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

2. ASTM C494/C494M-11, Standard Specification for Chemical Admixtures for Concrete

3. ASTM D1143/D1143M-07e1, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load.

4. ASTM D3689-07, Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.

G. FHWA NHI-05-039 "Micropile Design and Construction"

1.05 DESCRIPTION

A. Performance Requirements

1. Design, supply and install micropiles to meet the performance requirements indicated on Drawings.

2. Select the micropile type, size, size of reinforcement, pile top attachment, installation means and methods, depth of the required grout bond zone and final micropile diameter. The micropile contractor shall design and install micropiles that will develop the load capacities indicated on the Contract plans.

3. The Contractor shall design the connection of the pile top to the footing.

4. Furnishing and installation of the micropiles shall conform to the New York City Building Code and as specified herein. Where the requirements specified herein are more rigorous, they shall be adhered to.

5. The maximum permissible pile load with load test shall confirm to NYCBC Table 1810.4.1.3,.

6. Load tests, when required by the Contract, shall be performed in accordance with Section 31 09 16.20 - Pile Load.

B. Seismic Monitoring

1. When installing piles, the Contractor shall provide the monitoring stations at locations as specified herein or shown on the Contract Drawings.

2. All pile installation, removal of piling, and related pile activities shall be performed in a manner so that the following criteria shall not be exceeded; peak resultant particle velocity of one-inch per second at location of sensitive instruments and two-inches per second at concrete structures.

3. The Engineer reserves the right to change the locations of the monitoring stations, as required during construction. The Contractor shall engage the services of an approved geotechnical consultant (who shall be a registered

Professional Engineer in the State of New York) experienced in the monitoring of vibrations, to install, maintain and monitor an approved seismic monitoring system.

4. All pile installation vibrations shall be monitored for the duration of pile installation unless otherwise ordered to be discontinued by the Engineer. In the event that the monitoring is ordered to be discontinued a suitable credit shall be due DEP.

5. All vibration monitoring of specified locations shall be implemented in such a manner that peak component particle velocity can be determined shortly after instances where the vibrations exceed the above criteria. Both the Contractor and the Engineer shall be notified within 30 minutes after any such occurrence and the actual peak particle velocity identified.

6. Permanent vibrations monitoring records of each day's work shall be maintained until the completion of the work or until such time when monitoring is ordered to be discontinued. Such records shall be turned over to the Engineer upon completion of all seismic monitoring work. Monthly reports shall include a tabulation of all instances of vibration levels in excess of the seismic criteria noted above.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A minimum of 5 years' experience and not less than three successfully completed projects with similar soil and groundwater conditions, micropile size, depths, and volume of work contained in the project.

B. Professional Engineer Qualifications: A professional engineer who is registered in the jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated.

C. Survey Work: Engage a surveyor who is registered in the jurisdiction where the Project is located, to perform surveys, layout, and measurements. Conduct layout work for each micropile to lines and levels required before installation. Record actual measurements of installation of micropile foundation support systems.

1. Record and maintain information pertinent to each micropile and cooperate with the Owner's Geotechnical Engineer and Owner's Testing Agency to provide data required for reports.

D. Pre-construction Conference: A minimum two weeks prior to scheduled commencement of micropile installation and associated work, meet at Project Site with installer of micropiles, installers of related work, the Owner's Structural Engineer, Owner's Representative, Owner's Testing Agency, Owner's Geotechnical Engineer, and other representatives directly concerned with performance of the work. Review foreseeable methods and procedures related to micropile work. Record discussion of conference and decisions reached, and furnish copy of record to each party attending.

E. Construction Monitoring: The Contractor shall establish a construction monitoring program that includes a monitoring schedule, reviewing and interpreting data, and reporting to the Owner and Engineer as required to ensure safety of the existing adjacent structures, roads, sidewalks, buried utilities, and all other structures.

1.07 SUBMITTALS

A. General: Submit the following in accordance with Section 01 33 00, "Submittal Procedures".

B. Deferred-Design Submittal: The Contractor shall prepare and submit complete design calculations and working drawings. Include all details, dimensions, quantities, ground profiles, and cross-sections necessary to construct the micropile system. The working drawings and design submission shall be signed and sealed by the qualified professional engineer responsible for their preparation. This submittal shall include the following information:

1. Design Calculations:

a. A written summary report which describes the overall micropile design.

b. Applicable code requirements and design references.

c. Micropile structure critical design cross-section(s) geometry including soil/rock strata and piezometric levels and locations, magnitude and direction of applied design loadings, including slope or external surcharge loads.

d. Design criteria including ground-grout bond values, including safety factors or load and resistance factors.

e. Seismic design acceleration coefficient.

f. Calculations for pile-to-footing connection.

2. Working Drawings:

a. Pile location survey during installation

b. Additional pile locations

c. Final pile location survey

d. A plan view identifying location of all micropiles.

e. An elevation view identifying locations and elevations of all micropiles.

f. Design parameters and applicable codes.

g. General notes for constructing the micropile structure including construction sequencing or special construction requirements.

h. Micropile typical sections including micropile spacing, minimum drillhole diameter, pipe casing and reinforcing bar details, splice

types and locations, centralizers and spacers, grout bond zone and casing plunge lengths (if used), corrosion protection details, and connection details to the footing.

i. A typical detail of verification and production proof test micropiles defining the micropile length, minimum drillhole diameter, and load test bonded and unbonded test lengths.

j. Details, dimensions, and schedules for all micropiles, casing and reinforcing steel, including reinforcing bar bending details.

C. Informational-Only Submittals: To be submitted for record only and will not be reviewed.

1. Detailed step-by-step description of the proposed micropile construction procedure including personnel, testing and equipment to assure quality control. Include the following information:

a. Proposed micropile installation schedule.

b. Verification of headroom and space requirements for installation.

c. Proposed grouting plan.

d. Plan for control and disposal of surface water, drill flush, and excess waste grout.

2. Certified mill test reports for steel micropiles with ultimate strength, yield strength, elongation, and material properties composition.

3. Detailed plans for the proposed micropile load testing method. Include drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements.

D. Drilling Logs: The Contractor shall review, approve, and submit the drilling logs prepared by the Owner's Testing Agency for each micropile on a daily basis. Logs shall include identification, micropile diameter, bottom elevation, top elevation, nature and location of obstructions, and grout placement.

E. Reports: The Contractor shall submit to the Engineer within 14 calendar days after the completion of the micropile work a report containing the following:

1. As-built drawings showing the locations of the micropiles and the pile lengths.

2. Reinforcing steel mill test reports for the steel components incorporated into the installation.

3. Micropile test results and graphs.

4. Remarks, unusual conditions encountered, any deviations from requirements.

F. PROJECT CONDITIONS

1. Site Information: A geotechnical report has been prepared for this Project and is available for information only. The report is not part of the Contract Documents and is not guaranteed to represent conditions that will be encountered. Opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. DEP will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

    a. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to DEP.

    b. The geotechnical report is referenced elsewhere in the Project Manual.

2. Existing Utility Lines and Foundations: Any existing underground utility lines and foundations shown on the Contract Drawings are shown from the best possible information available and shall be verified prior to any excavation or grading work.

    a. Known utilities and foundations have been shown only where their existence has been determined by survey, investigation, or record drawings. The precise location of these lines, as well as careful reconnaissance of all areas for both above- and below-ground utilities as well as protection of same, shall be the sole responsibility of the Contractor.

    b. Existing utility lines to be retained and shown on the Civil Drawings, or the location of which are made known to the Contractor prior to excavation operations, shall be protected from damage during excavation drilling, filling, and backfilling, and if damaged, shall be repaired by the Contractor, at his expense, and in a manner as directed by the Engineer.

    c. New Utility Lines: New utility lines shown on the Civil Drawings, or the location of which are made known to the Contractor prior to concrete pier construction, shall be protected from damage during excavation, drilling, filling, and backfilling, and if damaged, shall be repaired by the Contractor, at his expense, and in a manner as directed by the Engineer.

3. The Contractor shall assume all responsibility for the premises and loss or damage to the property, adjoining property, public ways and utilities, shoring, bracing, and barricades and protecting adjacent property. All work shall conform to the requirements of the local jurisdiction. All costs for protecting, repairing, and replacing adjacent property shall be borne by the Contractor.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. General: Provide materials that are either new or in serviceable condition.

B. Reinforcing Bars: Steel core reinforcement as a minimum shall consist of deformed reinforcing bars in accordance with ASTM A722 Grade 150.

C. Cement: All cement shall be Portland cement conforming to ASTM C 150, Types II, III or V.

D. Recycled Content: Materials shall contain post-industrial (pre-consumer) recycled content and/or postconsumer recycled content where possible. Contractor shall document the cost and percentage (by weight) of each material broken out by post-industrial (pre-consumer) and post-consumer recycled content.

E. Regional Content: Materials shall contain content that is extracted, harvested, recovered, or manufactured within 500 miles of the Project Site. Contractor shall document the cost and percentage (by weight) of each material that is regional.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Coordinate the work and the excavation so the micropile structures are safely constructed. Perform the micropile construction and related excavation in accordance with the Construction Documents and Specifications.

3.02 IMPLEMENTATION

A. Pile Installation

1. The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The micropile contractor shall select the drilling method and the grouting procedures used for the installation of the micropiles, subject to the approval of the Departmental Representative.

2. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered and restraints of existing structures with minimal disturbance to these conditions or any overlying or adjacent structure or service. The borehole must be open to the defined nominal diameter, full length, prior to placing grout and reinforcement.

3. All installation techniques shall be determined and scheduled such that there will be no adverse effect on the achieved final set of adjacent piles.

4. Survey reference marks shall be placed on each pile immediately after installation and reference levels recorded. The Contractor shall resurvey the levels of all piles in a group after the group has been installed and while the piles are accessible.

5. Centralizers shall be provided at 10 feet center maximum spacing on central reinforcement. The uppermost centralizer shall be located a maximum of 5 feet from the top of the micropile, for micropile with continuous central bar, or at the bar end if central bar is not continuous through whole micropile length. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.

6. The central reinforcement steel with centralizers, shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole such that there will be no interconnection or damage to piles in which the grout has not achieved final set.

B. Grouting

1. The Contractor shall provide systems and equipment to measure the grout quality, quantity, and pumping pressure during the grouting operations. This information is to be measured and recorded.

2. After drilling, the hole shall be finished with water and/or air to remove drill cuttings, and/or other loose debris. The Contractor shall provide a stable, homogenous, neat cement grout or a sand cement grout with a minimum 28-day unconfirmed compressive strength of 4000 psi. The grout shall not contain lumps or any other evidence of poor or incomplete mixing. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressures gauge shall be capable of measuring

pressures of at least 150 psi or twice the actual grout pressure used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout shall be kept in constant agitation prior to pumping.

3. The grout shall be injected from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile. The tremie grout may be pumped through grout tubes, hollow stem augers, or drill rods. After tremie grouting, all grouting operations, associated with, for example, extraction of drill casing and pressure grouting, must ensure complete continuity of the grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of soil or rock formations. The entire pile shall be grouted to the design cut-off level.

4. Grout within the micropiles shall be allowed to attain the minimum design strength prior to being loaded.

C. Pile Survey

1. The Contractor shall engage the services of a New York State Licensed Land Surveyor, approved by the Commissioner, for the performance of the survey work. The Contractor shall, at such times so as not to interfere with the progress of the installation, make surveys of the installed piles. The installed location of each pile shall be established by survey and shown on drawings prepared for this purpose.

2. Drawings shall be submitted by the Contractor in accordance with the provisions as hereinafter specified in this Paragraph and in Article titled "Analysis and Corrective Measures" included in this Section. Survey information may be submitted on several drawings, each covering a partial area only, as the job progresses, in order to expedite the approval of the Work.

3. Upon completion of all pile installation, the Contractor shall submit to DEP, drawings showing installed location of all piles as related to their column lines, center of footings or other reference points and lines, percentage out of plumb, the butt elevation, and length below butt for each pile.

D. Analysis and Corrective Measures

1. The Engineer will analyze the conditions at each pile to determine whether corrective measures are required. If corrective measures are not required, approval will be given for proceeding with the Work.

2. The Engineer will determine the corrective measures required to keep pile loads within the allowable limits. Corrective measures, for any piles installed more than 3 inches from the plan location, will be determined by the Engineer. If the corrective measures are not deemed feasible, the pile

shall be removed in its entirety and replaced by another pile installed in the design location.

3. If corrective measures involve the installation of additional piles, the Engineer will prepare supplemental drawings showing the details of the required corrective work.

4. Cost of Additional Work:

a. The cost of installing additional piles (as called for on the supplemental drawings for the corrective measures), shall be borne by the Contractor in the case of rejected, defective, damaged or misplaced piles.

b. The cost will be borne by DEP in the case of obstructed piles ordered by the Engineer abandoned or in the case of modifications required because of the presence of obstructions.

c. Payment for corrective work necessitated by obstructed piles will be made in accordance with the applicable unit prices.

E. PILE SPLICES

1. Pile splices shall be constructed to develop the required design strength of the pile section.

2. Lengths of casing and reinforcing steel to be spliced shall be secured in proper alignment and in such a manner that no eccentricity between the axes of the two lengths spliced or angle between the results.

3.03 FIELD TESTING / QUALITY CONTROL

A. Inspection and Testing Company appointed as specified for Quality Control elsewhere in this Section, may perform sampling, inspection and testing of concrete and detailed inspection of piling operations including the following:

1. Monitor and record pile installation procedures.

2. Record installed pile lengths.

3. Confirm installed pile tolerances.

4. Monitor and analyze results of pile testing.

5. Confirm concrete strength in accordance with Section 03 30 00.

B. Load Test:

1. Pile load tests shall conform to the requirements of NYCBC Section 1810.4 and Section 31 09 16.10 Pile Load Tests, Compressive, Lateral and Uplift Loads.Adjusting / Protection / Cleanup

C. Damaged or Misplaced Piles

1. Remove from building site excess waste materials, cut-off piles and debris resulting from the Work of this Section. Leave premises in a condition acceptable to Departmental Representative on completion of Work.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide asphaltic concrete pavement roads and porous pavement constructed on properly prepared subgrades and in conformance to the required lines, grades and cross sections shown on the Contract Drawings.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	12
3.01	Examination / Preparation	12
3.02	Implementation	12
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	25
3.05	Adjusting / Protection / Cleanup	26

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 02 41 10 - Demolition and Removals

B. Section 31 23 16 - Excavation

C. Section 31 23 23 - Fill

1.04 REFERENCES

A. Definitions

1. California Bearing Ratio (CBR): The ratio of (1) the force per unit area required to penetrate a soil mass with a 19 sq. cm (3 sq.in.) circular piston (approximately 51 mm (2 in.) diameter) at the rate of 1.3mm/min (.05 in/min) to (2) that required for corresponding penetration of a standard material.

2. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

3. Typical Roll Value: Property value calculated from average or mean obtained from test data.

4. Warm Mix Asphalt (WMA): A technology that enables hot mix asphalt pavement to be produced, placed, and compacted at lower temperatures without compromising quality or performance.

B. Reference Standards

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m3))

3. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

4. ASTM D3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

5. ASTM D3786 - Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method

6. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

7. ASTM D4354 - Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing

8. ASTM D4355 - Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

9. ASTM D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity

10. ASTM D4533 - Test Method for Trapezoid Tearing Strength of Geotextiles

11. ASTM D4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
12. ASTM D4632 - Test method for Grab Breaking Load and Elongation of Geotextiles
13. ASTM D4759 - Practice for Determining the Specification Conformance of Geosynthetics
14. ASTM D4751 - Test Method for Determining Apparent Opening Size of a Geotextile
15. ASTM D4833 - Test Method for Index Puncture Resistance of Geomembranes and Related Products
16. ASTM D4873 - Guide for Identification, Storage and Handling of Geosynthetic Rolls and Samples
17. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
18. ASTM C29 - Test for Bulk Density (Unit Weight) and Voids in Aggregate
19. ASTM C33 - Specification for Concrete Aggregates
20. ASTM C1701 - Standard Test Method for Infiltration Rate of In-Place Pervious Concrete
21. AASHTO T 27 - Sieve Analysis of Fine and Coarse Aggregates
22. AASHTO T 88 - Standard Method of Test for Particle Size Analysis of Soils
23. AASHTO T 311 - Standard Method of Test for Grain-Size Analysis of Granular Soil Materials
24. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils
25. AASHTO T 90 - Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
26. AASHTO T 176 - Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
27. AASHTO T168 - Standard Method of Test for Sampling Bituminous Paving Mixtures
28. AASHTO T245 - Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

29. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP)
30. International Standards Organization (ISO) 9001 - Quality Management Systems — Requirements
31. New York State Department of Transportation (NYSDOT) Standard Specifications
32. NYSDOT Special Specifications – 420.40010001 Porous Asphalt Test Panel, 420.50130108 Porous Asphalt Pavement, 420.75000008 Vacuuming of Porous, Pervious and/or Permeable Pavements.
33. Federal Highway Administration- Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)
34. New York City Local Law 71 of 2011

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. The paving mix manufacturer shall be registered with and approved by NYSDOT.

B. Warm Mix Asphalt Technology

1. Shall be on the NYSDOT Approved List for Warm Mix Asphalt Technologies.

C. If Recycled Asphalt Pavement (RAP) exceeds 50% of total aggregate, fractionation will be required. Fractionation is the mechanical separation (sieving) of RAP into sand RAP and stone RAP fractions. Fractionated RAP stockpiles shall be tested for gradation and asphalt content separately, and shall be listed as separate lines on mix designs. The fractionation limit shall be shown on the mix design.

D. The porous asphalt pavement contractor shall submit evidence of at least one successful porous asphalt pavement project greater than 1000 sq. ft. including, but not limited to the following:

1. Project name and address, owner name and contact information.

E. Sub-base materials shall comply with the testing and certification requirements of Section 31 23 23 – Fill.

F. Recycled Portland Cement Concrete Aggregate shall comply with the procedures contained in the Geotechnical Control Procedure (GCP-17) “Procedure for the Control and Quality Assurance of Granular Materials: as per NYSDOT Standards and Specifications Section 733-07.

G. Geotextile fabric manufacturer shall be approved by NYSDOT.

H. Manufacturers shall comply with ASTM D3666.

1.07 SUBMITTALS

A. The Contractor shall submit shop drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Geotextile

a. Manufacturer's literature including physical, mechanical and chemical properties of the geotextile.

b. Certification of geotextile's minimum MARVs and tests used to determine those properties.

c. Certificate of Compliance stating that the geotextile conforms to the Specifications and the manufacturer is aware of and agrees with its intended use.

d. Geotextile manufacturer's qualifications: ISO 9001 certified or equivalent.

e. Manufacturing quality control test results on geotextiles.

2. Asphalt Concrete

a. The bituminous mix design for both the binder course and the top course, which shall include the sources of all ingredient materials, Recycled Asphalt Pavement (RAP) content by weight, the penetration of the asphaltic cement and the percentages by weight and the number of pounds of each of the materials making up one batch.

1) The laboratory analysis of the bituminous mix and the laboratory compacted density.

3. Recycled Portland Cement Concrete Aggregate (RCA) Material

a. Name of location of all suppliers.

b. Certificate of compliance with standard specified for each source of material.

c. Prior to stockpiling or placing of materials at the job site, submit for approval samples representative of the material at the proposed borrow source. In addition, submit documentation of the availability of the required material quantities at any proposed borrow source.

d. Certification by the material borrow source of the gradation as per ASTM D 422 for the gravel, RCA and any other materials being used. The minimum number of tests shall be determined by quantity of material placed, and reports of the test results shall be submitted promptly.

e. RCA shall also comply with the testing and certification requirements of Section 31 23 23 – Fill.

4. Warm Mix Asphalt Technology

a. The warm mix asphalt technology product information, implementation instructions, impact on the asphaltic concrete design mix, and pavement installation instructions.

5. Porous Asphalt Pavement

a. Top and Binder Course Materials:

1) Proposed top and binder course mixture proportions including all material weights, volumes, density, PG binder, and void content. If mix proportions are proprietary, a written submittal from the asphalt supplies will be required documenting a minimum of two prior successful projects using the same mix design. The density, and void content is still required to be reported.

2) Aggregate type, source and gradation.

3) Cement, supplementary cementitious materials, and chemical admixture manufacturer certifications all meeting the appropriate ASTM requirements.

b. Proposed aggregate for use in base layer: washed aggregate type, source, grading and void content (percent porosity)

c. Plan for Placement: Project details, schedule, construction procedures and any additional quality control information

d. For cold weather placement, (45 degrees or lower during the next 7 days following placement) submit a procedural plan to monitor/protect the asphalt.

e. Subcontractors: List all material suppliers, subcontractors and testing laboratories to be used on the project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered to the site shall be stored in a manner to prevent contamination and segregation.

B. Geotextile

1. Geotextile delivery, storage, and handling shall comply with the requirements of NYSDOT Standard Specifications Section 207-3.01.

2. Wrap geotextile in black protective wrap.

3. The geotextile rolls shall be labeled as per ASTM D4873.

4. Deliver, store and handle rolls in manner to prevent damage.

5. After unloading, inspect rolls for defects and damage.

6. Protective wrapping should not be removed until ready for installation. Do not leave covered rolls exposed to elements for more than 30 days unless

additional heavy-duty waterproof cover is provided. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding 14 days.

7. Store rolls off ground, protected from precipitation, ultraviolet radiation, strong chemicals, sparks and flames, temperatures in excess of 160 °F and other environmental conditions that could cause damage to geotextile.

8. Prevent damage to wrappings and geotextile.

9. Rolls should be deployed as closely as possible to the designated location to avoid dragging. Excessive stress and movement should be kept to a minimum.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Test Panels (Porous Asphalt Pavement)

1. Prior to construction, a test panel shall be constructed in accordance with NYSDOT Special Specification 420.50130108, except as noted below.

2. A panel that fails requires another test panel placement until approved.

3. The test panel will be constructed in accordance with the plans and specifications. The test area will be a minimum of 2 cubic yards or a 100 sq. ft. area, as determined by the Engineer at the design depth. The panel shall be installed, consolidated, jointed and cured using the materials, equipment, and personnel proposed for the Project. The test panels are to demonstrate to the Engineer that the in-place densities can be achieved, acceptable permeability can be achieved, and satisfactory pavement can be installed at the Site location.

4. The test panel can be constructed on-Site in an area for demolition after test approval or in a predetermined area that may be saved and used. If the test proves to be unsatisfactory by the specifier, it will be removed and replaced until accepted. If the actual Site is too small or limited, the specifier and contractor shall come to an agreement for an alternative test site.

5. The cost for removal of the test panel, if necessary, shall be included in the contract proposal and contract. The test panel may be placed at any of the specified porous asphalt pavement locations on the Project Site or other test site.

6. Quality: Test panels shall have acceptable surface finish, thickness, porosity and curing procedures and shall comply with the testing and acceptable standards listed in the quality control section of this document.

7. Satisfactory performance of the test panels shall be determined by:

a. Organized construction team with all the proper equipment at hand and used on the test installation, consolidating the surface to a satisfactory thickness and smoothness.

b. Porosity Test. Allow a minimum of 24 hours after completion of the Top Course, before testing. Perform a porosity test at 3 locations chosen by the Engineer-in-charge. At each location, test the porosity for a minimum of 3 minutes. The test is accomplished by applying clean water at a measured rate of at least 5 gal/min over the surface, using a hose or other distribution device. Water used for the test shall be clean, free from suspended solids and deleterious materials and will be provided at no additional cost. All applied water shall infiltrate the test panel directly, without puddle formation or surface runoff, and shall be observed by the Engineer-in-charge.

8. Review of the testing information from the Test Panel construction should indicate desirable results.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Geotextiles shall be as manufactured by:

1. Propex Fabrics, Chattanooga, TN;
2. TenCate Geosynthetics, Pendergrass, GA;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Geotextile: Provide geotextile fabric conforming to the requirements specified in this Section:

1. Woven high-performance/high-strength slit film polypropylene geotextile; individual slit films woven together in manner to provide dimensional stability relative to each other.
2. Resistant to ultraviolet degradation and biological and chemical environments normally found in soils.
3. Minimum Average Roll Values:

Property	Test Method	Units	Results
Wide Width Tensile Strength	ASTM D4595	kN/m (lbs/in)	31x30.6 (175 x 175)
Grab Tensile Strength	ASTM D4632	N (lbs)	1335 x 1335 (300 x 300)
Grab Elongation	ASTM D4632	Percent	15 x 15

Property	Test Method	Units	Results
Puncture Strength	ASTM D4833	N (lbs)	555 (125)
Mullen Burst	ASTM D3786	KPa (psi)	4475 (650)
Trapezoidal Tear	ASTM D4533	N (lbs)	530 x 530 (120)
Apparent Opening Size	ASTM D4751	mm	0.212
Permittivity	ASTM D4491	sec-1	0.06
Water Flow Rate	ASTM D4491	$1/min/m^2$ (gpm/ft^2)	200 (5)
UV Resistance (percent retained at 500 hours)	ASTM D4355	Percent	90

B. Provide asphaltic concrete pavement for roadways conforming to the requirements specified in this Section and to the following standards:

1. Base Course of Recycled Concrete Aggregate as follows:

   a. Base material shall have a maximum particle size of 3-in. in any directions and a nominal size of 2-in.

   b. Use materials with not more than 30 percent by weight of glass. Use a blend of at least 95 percent, by weight, of RCA, and free from organic and other deleterious material. This material shall not contain asphalt or brick.

   c. Provide documentation showing that the RCA material was obtained from a NYSDEC registered or permitted construction and demolition (C&D) debris processing facility as specified in Section 360-16.1 of 6NYCRR Part 360 “Solid Waste Management Facilities” and complying with the regulatory requirements and regulations of Section 31 23 23 – Fill. This material shall be procured from a NYSDOT approved source.

   d. Base material shall meet the specification material requirement and must be able to be placed and fine graded to the required tolerances. Should the base course become unstable at any time prior to the placement of the overlying course, correct the unstable condition to the satisfaction of the Engineer at no additional cost to DEP. Perform any required modification prior to placing the material on the grade.

   e. A Geotextile shall be used to separate the sub-grade layer from the base course.

2. Tack Coat: Asphalt emulsion per NYSDOT Standard Specifications, Sections 407 and 702.

3. Binder Course: Binder mixture as specified in the Contract Drawings per NYSDOT Standard Specifications, Sections 401, 402 and 702, incorporated with a WMA technology.

4. Top Course: Asphaltic concrete mixture as specified in the contract drawings per NYSDOT Standard Specifications, Sections 401, 402 and 702, incorporated with a WMA technology.

5. Warm Mix Asphalt Technology for Binder and Wearing Course: Foaming Processes, NYSDOT Standard Specifications, Section 712-10.

C. Asphaltic concrete shall contain not less than 50 percent reclaimed asphaltic pavement, as measured by weight.

D. Traffic and Parking Markings:

1. Colors: In accordance with the MUTCD.

2. Conform to NYSDOT Standard Specifications Section 727 – Pavement Marking Materials.

E. Porous Asphalt Pavement

1. Filter Fabric shall be needled, non-woven, polypropylene geotextile with the following qualities:

Property	Test Method	Units	Results
Grab Tensile Strength	ASTM D4632	N (lbs)	530 (120)
Mullen Burst	ASTM D3786	KPa (psi)	1550 (225)
Apparent Opening Size	ASTM D4751	US Sieve	#80
Water Flow Rate	ASTM D4491	gpm/ft^2	125

2. Base Layers shall conform to ASTM C33 standards, and shall be per the Contract Documents for the specified stone size and minimum layer depth.

3. Binder Course shall be Type F9 and as defined in the NYSDOT special specification 420.50130108.

4. Top Course shall be Type F3 with mineral fibers and as defined in the NYSDOT special specification 420.50130108.

5. The use of tack coat between layers is prohibited for porous asphalt pavement.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Quality Control of Geotextile

1. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP, or approved equal, for tests required for the geotextile, at frequency exceeding ASTM D4354, with following minimum acceptable testing frequency:

Property	Test Method	Test Frequency sq m (sq ft)
Grab Tensile Strength	ASTM D4632	1/10,000 (100,000)
Grab Elongation	ASTM D4632	1/10,000 (100,000)
Trapezoidal Tear	ASTM D4533	1/10,000 (100,000)
Mullen Burst	ASTM D3786	1/10,000 (100,000)

2. Conformance Testing:

   a. Upon delivery to Site, Engineer will remove samples of geotextile and send to laboratory for testing.

   b. Testing will be performed at a laboratory accredited by GAI-LAP, or approved equal, in accordance with ASTM D4759, Practice A.

B. RCA Material

1. Provide materials for base course that consist of sand, gravel, approved blast furnace slag, RCA, or stone that meet the requirements of this specification. Provide materials well graded from coarse to fine, and free from organic or other deleterious material. Any gravel material will be rejected if it is determined to contain any unsound or deleterious materials.

2. Testing: The Contractor shall retain the services of an independent materials testing laboratory to perform the following laboratory and field tests:

   a. Gradation: Perform sieve analysis in accordance with ASTM/AASHTO procedures C136/T 27, T 88, T 311, T 89 or D 4318/ T 90. Report the following sieves for all tests: #200, #40, ¼ in., ½ in., ¾ in., 1 in., 1 ½ in., 2 in., 3 in.

   b. Soundness: Provide material that complies with the soundness limits specified in the NYSDOT Standard Specifications. Material will be accepted on the basis of Magnesium Sulfate Soundness Loss after four (4) cycles performed according to NYSDOT Standard Specifications.

   c. Plasticity: Determine plasticity using either of the following methods:

      1. Plasticity Index: The Plasticity Index of the material passing the #40 mesh sieve shall meet the values of the Table 1. Determine the plasticity using AASHTO T 89 and ASTM D4318/AASHTO T 90.

2. Sand Equivalent: The sand equivalence of the granular material shall meet the values in Table 1. Determine sand equivalence using ASTM D2419 or AASHTO T 176.

d. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a ½-in. sieve shall consist of flat or elongated particles. A flat or elongated particle is defined as one which hast it greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be based on a visual inspection. When the Engineer elects to test for this requirement, material with a percentage greater than 30 will be rejected.

e. Fractured Faces: When the Engineer elects to test for this requirement, Surface material shall have at least two fractured faces on 50 percent of the stone particles larger than ½ in. Base material shall have at least one fractured face on 50 percent of the stone particles larger than ½-in.

3. All materials used in construction, whether brought to the site or developed from on-site sources, shall be tested for gradation, optimum moisture-maximum density curve, and reports of the test results for each source shall be submitted promptly. The tests will be performed in conformance with the procedures contained in the appropriate NYSDOT publications and ASTMs listed in Section 1.04 - References.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. The Resident Engineer shall conduct a pre-pave meeting in accordance with NYSDOT Standards and Specifications Section 402-3.

B. Full Depth Asphaltic Concrete Pavement

1. General: Asphaltic concrete pavement roads shall consist of

a. A layer of woven geotextile fabric,

b. A base course

c. A tack coat of asphalt emulsion,

d. An intermediate binder course of asphaltic concrete (close binder type),

e. A tack coat of asphalt emulsion, and

f. A top course of fine surface mix asphaltic concrete (top course).

2. Preparation of Subgrade:

a. Per Section 31 23 16 – Excavation, remove to a depth of 24 inches, top soil, boulders, muck, soft clay, spongy material and any other objectionable material and replace them with broken stone, sand and gravel or other approved fill to promote positive drainage.

b. On sites where it appears that there may be some areas containing objectionable materials, proof roll to locate the unsuitable materials.

c. Exercise care during stripping operations to prevent excessive disturbance to subgrade. Use lightweight dozers or grade-alls for low strength, saturated, noncohesive and low cohesive soils.

d. For extremely soft ground such as peat bog areas, do not over excavate surface materials to take advantage of root mat strength.

e. If vegetation is present, cut at ground surface and place sawdust or sand over stumps and roots extending above ground surface.

f. Scrape and fill subgrades, as necessary, and thoroughly consolidate them to the required lines and grades. Consolidate subgrades for pavements by means of a smooth steel-wheel roller having a nominal gross weight of not less than 10 tons, and exerting a minimum force of not less than 300 lbs/in of width on the compression roll faces, or approved equivalent.

g. Compact subgrade to not less than 75 percent relative density as determined by ASTM D4253, or not less than 95 percent of the maximum dry density as determined by ASTM D1557, as applicable.

h. In places where the use of a roller is impractical, compact subgrades with hand tampers weighing not less than 40 lbs. and having a face not exceeding 80 sq.in. in area.

i. Subgrade shall be prepared not less than 100 ft. in advance of the pavement to be immediately constructed.

3. Installation of Geotextile:

a. After subgrade has been prepared, place geotextile in same direction as the new roadway aggregate is being laid down.

b. Do not drag geotextile across subgrade. Place entire roll on subgrade surface and roll out smoothly. Remove wrinkles and folds by stretching and holding down with sandbags as required.

c. Join parallel rolls of geotextile as follows:

California Bearing Ratio (CBR)	Method of Joining
OVER 2	300-450 mm (12-18 in) overlap

1-2	600-900 mm (24-36 in) overlap
0.5-1	900 mm (36 in) overlap or sewn
Less than 0.5	Sewn
All roll ends	900 mm (36 in) overlap or sewn

d. If the CBR of the subgrade is not known, join parallel rolls by sewing them together.

e. For subgrades with CBR less than or equal to 1, where the geotextile is to provide reinforcement, the geotextile shall be pretensioned in the following manner:

1) Proof roll with heavily loaded, rubber-tired vehicle. Wheel load of truck shall be equivalent to maximum expected for site. Vehicle to make at least four passes over first lift in each area of Site.

2) Once design aggregate has been placed, use roadway prior to paving to prestress geotextile-aggregate system.

f. If required, the geotextile may be held in place prior to subbase placement with sandbags. The use of pins to anchor the geotextile will not be permitted, except at edges of existing pavement as specified below.

g. Do not place overlaps along anticipated primary wheel path locations. Place overlaps at end of rolls in direction of aggregate placement with previous roll on top.

h. When sewn seams are required, strength of seams shall be greater than or equal to 80 percent of tensile strength of unseamed geotextile as determined by same testing methods.

i. When placing woven geotextile on curves, fold or cut geotextile and overlap in direction of turn with previous fabric on top. Staple or pin folds in geotextile approximately 2 ft on center.

j. When geotextile intersects an existing pavement area, extend geotextile to edge of old system and anchor it by trenching and covering the edge of the fabric with stone, or staple or pin the fabric to the ground. For widening or intersecting existing roads where geotextiles have been used, excavate edge of roadway down to existing geotextile and sew the new geotextile to the existing geotextile, or overlap and staple or pin the new fabric to the old and into the ground.

k. Prior to covering, inspect geotextile for excessive damage, including holes, rips and tears.

1) If excessive defects are observed, repair affected area by placing new layer of geotextile over damaged area.

2) Extend new layer beyond damaged area the same distance as required for overlap of adjacent rolls.

l. End-dump base aggregate on previously placed aggregate. End dumping or tail-gate dumping of the aggregate directly on the geotextile will not be permitted.

1) For subgrades with CBR less than or equal to 1, limit pile heights to prevent possible subgrade failure.

2) Maximum placement thickness for subgrades with CBR less than or equal to 1 shall not exceed design thickness of road.

m. Spread and grade first lift of aggregate to 12 in. or to design thickness if less than 12 in. prior to compaction. Do not allow traffic on soft roadway with less than 8 in. of aggregate over geotextile, except 6 in. for CBR greater than or equal to 3.

n. Compact the base course as specified. Vibratory compaction shall not be used on the initial lift over the geotextile.

o. Perform construction parallel to road alignment.

p. Fill ruts formed during construction to maintain adequate cover over geotextile. Do not blade ruts down.

q. Place remaining base aggregate in lifts not exceeding 250 mm (10 in) in loose thickness and compact to specified density.

r. Equipment may operate on roadway without aggregate for geotextile installation under permeable bases if subgrade is of sufficient strength.

1) For soils with CBR less than or equal to 0.5, use lightweight construction vehicles for access on first lift.

2) Limit construction vehicles in size and weight to limit rutting in initial lift to 3 in.

3) If rut depths exceed 3 in, decrease construction vehicle size or weight or increase lift thickness.

s. Turning will not be permitted on first lift of base aggregate. Construct turn-outs at roadway edge to facilitate construction.

4. Base Course:

a. Spreading

1) Spread the No. 1 and No. 2 stone or RCA uniformly on the geotextile with shovels from piles along the side of the roadway or from dumping boards or by means of vehicles of

approved design constructed especially for this purpose, but in no case dump the material directly on the geotextile.

2) The loose lift thickness shall be a minimum of 1.5 times the maximum particle size. The Contractor shall control the lift thickness, provided that the thickness shall not exceed the thickness limitations specified herein, for installation of aggregate over geotextile, and shall not exceed the maximum allowed according to the equipment classifications in Subparagraph 2, *Compaction Equipment* of Subsection 203-3.03.C, Compaction, of New York State Department of Transportation Standard Specifications, and the equipment meets all specified class criteria of that Standard.

3) Spread broken stone or RCA in sufficient quantity to provide the required thickness after rolling. The depth of stone shall be gauged by the use of cubical concrete blocks of the required thickness, or other approved means.

4) Remove all segregated fine or coarse stone and replace it with well graded stone.

5) Do not spread the broken stone or RCA over wet geotextile.

6) Do not place broken stone or RCA adjacent to manhole heads or other structures until such structures have been set to the required lines and grades.

b. Rolling and Filling

1) After the No. 1 and No. 2 stone or RCA mixture has been laid loose, thoroughly roll it with an approved smooth steel-wheel roller having a nominal gross weight of not less than 10 tons and exerting a minimum force of 300 lbs/in of width on the compression roll faces.

2) Start rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of a rear wheel. A minimum of 8 passes shall be applied over each lift with the roller operating at a speed not exceeding 6 feet per second. Rolling shall be continued until there is no movement of the stone ahead of the roller.

3) After the base is thoroughly compacted, as measured by the method described in Paragraph f, below, uniformly spread No. 4 stone over the compacted area from piles along the side of the roadway or from dumping boards. Broom the filler in and roll it dry until no more filler can be forced into the voids. Remove excess filler.

4) Do not lay over 500 linear feet of the base without it being rolled and thoroughly filled.

5) The maximum layer thickness prior to compaction shall be 12 in., and the final compacted thickness shall be as shown on the Contract Drawings. In confined areas as defined by the Engineer the maximum compacted layer thickness shall be 6 in.

6) Do not allow the surface of the completed base to deviate more than ¼ inch in 5ft from the nearest point of contact nor more than 3/8-in in 18ft when tested by means of an 18ft straight-edge placed parallel to the centerline of the roadway.

7) If any irregularities develop in the surface during or after rolling of the base, remedy them by loosening the surface and removing or adding broken stone or RCA as may be required, and follow by rolling the entire area, including the surrounding surface, applying filler and continuing rolling until the course is compacted satisfactorily to a uniform surface.

5. Binder Course:

a. Preparation: Clean the binder course of all dirt and loose material, thoroughly dry it and obtain the Resident Engineer's approval before laying the binder course.

b. Weather Limitations: Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F, or when other weather conditions would prevent proper construction of the pavement.

c. Forms: When side forms are required, accurately set them to line and grade and securely stake and brace them in place sufficiently to withstand all construction operations. Thoroughly clean and oil forms before use.

d. Spreading:

1) Dump the binder course into the hopper of the spreader. Spread and screed it immediately to the full width required for the pavement and to such a depth that, when rolled, the required thickness is obtained. The maximum allowable compacted thickness for binder shall be 4 in. The maximum allowable compacted thickness for base shall be 6in.

2) When the mixture is to be spread by hand, dump it on approved steel dump sheets outside of the area on which it is

to be spread and immediately distribute it into place and spread it in a uniformly loose layer.

3) Remove material from areas which show an excess or lack of bituminous material or an inconsistent mix and fill with new material. Re-spread or otherwise rectify areas which show segregation to obtain a uniform mixture in the course.

4) Do not use mixture which has been over 45 minutes out of the mixer, or if longer, the mixture must be over 250°F when spread.

5) Do not lay over 500 lineal feet of binder material without it being rolled and properly compacted.

e. Compacting:

1) 50 Series Compaction Method: Contractor shall compact HMA according to NYSDOT Standard Specifications Section 404-3.07A.

2) 60 Series Compaction Method: Contractor shall compact HMA according to NYSDOT Standard Specifications Section 404-3.07B.

3) 70 Series Compaction Method: Contractor shall compact HMA according to NYSDOT Standard Specifications Section 404-3.07C.

4) 80 Series Compaction Method: Contractor shall compact HMA according to NYSDOT Standard Specifications Section 404-3.07D.

6. Tack Coat:

a. Before spreading the binder course, spray the base with an asphalt emulsion tack coat in the amount of 0.25 gallon per square yard. Allow the tack coat to cure until sticky or tacky. Renew and repair or replace damaged coating.

b. Tack coat shall be applied evenly by means of a truck having appropriate spray nozzles. All nozzles shall be kept free of clogs.

c. Paint contact surfaces of all curbing, gutters, manholes and adjacent pavement edges with the tack coat material.

d. Tack coat shall not be applied on a wet pavement surface or when the temperature is below 45° F.

7. Top Course:

a. Preparation:

1) Thoroughly clean the binder course of all loose and foreign material before the top mixture is delivered.

2) Apply a tack coat at a rate of 0.03 to 0.07 gallon per square yard as approved by the Engineer.

3) Do not lay mixture until the Engineer approves the binder course and determines in all cases whether the weather conditions are suitable to permit laying.

b. Weather Limitations: Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 45° F, or when other weather conditions would prevent proper construction of the pavement.

c. Forms: If at the time of laying the mixture, permanent side supports such as curbs, edgings or gutters have not been constructed, firmly fasten in place suitable side forms of wood or steel, true to line and grade. In all cases adequately support the sides of roadways until final compaction has been obtained and the mixture has hardened by cooling.

d. Spreading and Compacting:

1) Spread and compact the top course until it meets the compaction and surface requirements specified above for the binder course.

2) The Contractor shall have the same options for achieving the required compaction as given for the compaction of the binder course.

3) Do not lay over 500 lineal feet of top course material without it being rolled and properly compacted.

4) Do not use mixture which has been over 45 minutes out of the mixer, or if longer, the mixture must be over 250° F when spread.

e. Joints: Perform construction as near continuously as possible. Carefully make joints between old and new pavements, or between successive days' work, in a manner which will insure a thorough and continuous bond, as follows:

1) Cut back the edge of the old surface before recommencing the operation of laying, in order to present a fresh, clean surface for contact with the newly placed material.

2) Carefully employ hot smoothing irons to heat the old pavement sufficiently (without burning) to insure a proper bond.

f. Shoulders: If temporary forms are used, protect the edges of the finished roadway by placing and thoroughly compacting approved material to form shoulders along the roadway as shown on the

Contract Drawings. Construct finished shoulders 1/4 inch above the elevation of the finished roadway edges.

g. If weather conditions necessitate delaying the installation of the top course for more than two days, the tack coat shall be reapplied to the binder course at the rate of 0.03 to 0.07 gallon per square yard as approved by the Engineer.

C. Porous Asphalt Pavement

1. General: Porous Asphalt pavement shall consist of:

a. A layer of filter fabric,

b. A base stone course with an underdrain (if required),

c. A tack coat of asphalt emulsion for vertical faces of curbs and edges of structures

d. An intermediate binder course of asphaltic concrete,

e. A top course of fine surface mix asphaltic concrete (top course).

2. Preparation of Subgrade:

a. Clean all underlying surfaces of all debris and loose material by sweeping with hand brooms, power sweepers or blowers.

b. Edges of all previously placed pavement courses abutting the newly placed pavement Work shall be saw cut before new material is placed against it.

c. Verify in-pavement utility castings and appurtenances are set to finished grade.

d. Compact subgrade to 90 percent (+/- 2 percent) of the maximum dry density per standard Proctor test (ASTM D698), or as directed by the Geotechnical Engineer. Determination of in-place density shall be made using a nuclear gauge per ASTM D6939.

e. Areas of the subgrade which are over-compacted, as determined by the Geotechnical Engineer, shall be ripped/tilled to a depth of 12 inches (minimum) or as directed by the Geotechnical Engineer, and shall be recompacted. Contractor shall locate all utilities within pavement footprint prior to ripping and re-compacting subgrade.

f. Proof-roll prepared subgrade with loaded dump truck, remove soft spots, and replace with permeable structural fill as directed by the Engineer to achieve uniform subgrade.

g. After compaction and proof roll, scarify subgrade ¼ to ½ inch deep by hand rake. Once scarified, materials or equipment shall not be permitted within the prepared subgrade area so as to avoid recompaction or clogging of the scarified subgrade.

h. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at their discretion before the contractor may proceed with the base layer installation.

3. Installation of Filter Fabric:

a. After subgrade has been prepared, place geotextile in same direction as the new roadway aggregate is being laid down.

b. Do not drag geotextile across subgrade. Place entire roll on subgrade surface and roll out smoothly. Remove wrinkles and folds by stretching and holding down with sandbags as required.

c. Place geotextile filter fabric in accordance with the manufacturer's standards and recommendations. Adjacent strips of filter fabric shall overlap a minimum of 16 in. The filter fabric shall be placed on the floor of the excavation and up the vertical face of the excavation, stone detention and pervious layer. The contractor shall secure fabric at least 2ft. outside of the pervious pavement and base layer.

d. Preventive measures (hay bales, silt sack/fence) shall be implemented to prevent any runoff or sediment form entering the storage bed.

e. Prior to covering, inspect filter fabric for excessive damage, including holes, rips and tears.

1) If excessive defects are observed, repair affected area by placing new layer of filter fabric over damaged area.

2) Extend new layer beyond damaged area the same distance as required for overlap of adjacent rolls.

f. End-dump base aggregate on previously placed aggregate. End dumping or tail-gate dumping of the aggregate directly on the filter fabric will not be permitted.

g. Fill ruts formed during construction to maintain adequate cover over filter fabric. Do not blade ruts down.

h. Turning will not be permitted on first lift of base aggregate.

4. Base Course:

a. Compact base layer(s), in six (6) inch (maximum) lifts, by making a minimum of three passes over the base material with a ten (10) ton vibratory roller, or as directed by the Geotechnical Engineer. All passes shall be in static mode. Acceptance of the pavement base will be based on Engineer's observation of aggregate movement during final compaction pass. Compaction equipment shall be accepted by the Engineer prior to use.

1) A 13,500 lbf minimum vibratory roller compactor with a compaction indicator shall be utilized in areas where a

vibrator roller is impractical. At least two passes should be made over each lift of the base layer(s).

b. Hay bales or equivalent shall be placed at the toe of slopes which may be adjacent to beds to further prevent sediment from washing into beds during site development. As the site is fully stabilized, excess filter fabric along the bed edges can be cut back.

1) Form materials are permitted to be of wood or steel and shall be the full depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations.

5. Binder and Top Course:

a. Preparation: Clean the binder course of all dirt and loose material, thoroughly dry it and obtain the Resident Engineer's approval before laying the binder course.

b. Weather Limitations: Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F, or when other weather conditions would prevent proper construction of the pavement.

c. Forms: When side forms are required, accurately set them to line and grade and securely stake and brace them in place sufficiently to withstand all construction operations. Thoroughly clean and oil forms before use.

d. Spreading:

1) Dump the binder course into the hopper of the spreader. Spread and screed it immediately to the full width required for the pavement and to such a depth that, when rolled, the required thickness is obtained. The maximum allowable compacted thickness for binder shall be 4 in. The maximum allowable compacted thickness for base shall be 6 in.

2) When the mixture is to be spread by hand, dump it on approved steel dump sheets outside of the area on which it is to be spread and immediately distribute it into place and spread it in a uniformly loose layer.

3) Remove material from areas which show an excess or lack of bituminous material or an inconsistent mix and fill with new material. Re-spread or otherwise rectify areas which show segregation to obtain a uniform mixture in the course.

4) Do not use mixture which has been over 45 minutes out of the mixer, or if longer, the mixture must be over 250°F when spread.

e. Compacting:

1) The type of rollers to be used and their relative position in the compaction sequence shall be dictated by the contractor provided the requirements below are met and the completed porous asphalt meets the required quality characteristics. Deviation from the requirements below must be approved in advance by the Engineer.

2) The porous asphalt shall be laid in lifts of up to 4 inches in thickness using approved equipment to achieve the total thickness indicated in the Plans.

3) Breakdown rolling shall be performed with one or two passes of a 7.5 to 10 ton vibratory roller operated in static mode when the mix temperature is within the supplier-recommended temperature range.

4) Finished rolling shall be performed with a double-drum finish roller operated in static mode when the mix temperature is within the supplier-recommended temperature range.

5) Finished paving shall be even, without pockets, and graded to elevations shown on the Plans.

6) The Contractor shall take care to insure that the porous asphalt lifts join completely to previous lifts. The Contractor shall keep the time between lift placements to a minimum, keeping the surface of the previous lift clear from dust and moisture between lifts, and restrict traffic from initial lifts until the full depth of asphalt pavement has been placed.

7) Sufficient time shall be allowed between lifts to allow the asphalt to set and cool to at or below the supplier recommended maximum temperature for placement of subsequent lifts.

f. Joints: Perform construction as near continuously as possible. Carefully make joints between old and new pavements, or between successive days' work, in a manner which will insure a thorough and continuous bond, as follows:

1) Cut back the edge of the old surface before recommencing the operation of laying, in order to present a fresh, clean surface for contact with the newly placed material.

2) Carefully employ hot smoothing irons to heat the old pavement sufficiently (without burning) to insure a proper bond.

6. Tack Coat:

a. Before spreading the binder course, paint contact surfaces of all curbing, gutters, manholes and adjacent pavement edges with the tack coat material.

b. Tack coat shall not be applied on a wet pavement surface or when the temperature is below 45° F.

D. Mill and Overlay

1. Conform to NYSDOT Standard Highway Specifications, Section 490 for cold milling of existing pavement.

2. Milling shall conform to Section 02 41 10 – Demolition and Removals.

3. Conform to NYSDOT Standard Highway Specifications, Section 401, 402 and 702 for new top course.

4. Mill to the thickness shown in the Contract Drawings or as directed by the Engineer.

5. Follow requirements for Top Course as specified herein.

E. Patching

1. As directed by Resident Engineer, remove and replace defective areas. Cut such areas and replace with fresh asphaltic concrete and compact to required density.

F. Pavement Marking

1. Clean with power and hand brooms.

2. Mark edges straight and uniform. Use two coats and comply with manufacturer's recommendations.

3.03 FIELD TESTING / QUALITY CONTROL

A. Pavement Density Testing/Monitoring

1. Contractor shall conduct the following pavement density monitoring operations depending on the pavement design compaction series indicated in the Contract Drawings:

a. 50 Series Compaction: Contractor shall extract pavement cores, in accordance with NYSDOT Section 402-3.08A, and deliver to the Regional Materials Laboratory in accordance with NYSDOT standard specifications Section 402-3.08E, for density testing.

b. 60 Series Compaction: Contractor shall monitor pavement density using density gauges in accordance with NYSDOT Standard Specifications Section 402-3.07B. The density gauges used to

monitor pavement density shall follow the requirements specified in NYSDOT Standard Specification Section 402-3.07E. In addition to density gauge measurements, contractor shall extract pavement cores, in accordance with NYSDOT Standard Specifications Section 402-3.08A, and deliver to the Regional Materials Laboratory in accordance with NYSDOT Standard Specifications Section 402-3.08E, for density testing.

c. 70 Series Compaction: Contractor shall monitor pavement density using density gauges in accordance with NYSDOT Standard Specifications Section 402-3.07C. The density gauges used to monitor pavement density shall follow the requirements specified in NYSDOT standard specification section 402-3.07E.

d. 80 Series Compaction: Density testing is not required. Contractor shall place and compact HMA as per NYSDOT Standard Specifications Section 402-3.07D.

2. When required by the Engineer, furnish 4-inch diameter test samples cored from the binder course and from the completed pavement. The Engineer will choose the number of cores and the locations at which the cores shall be taken. Sample cores, when required, shall be taken for every 10,000 square feet of pavement and patch. Density test shall show that the sample is within 90 percent of the laboratory specimen. Replace with new mixture and refinish the areas of pavement so removed without additional compensation.

B. ASTM C1701, Infiltration Rate of In-Place Pervious Concrete

1. An infiltration ring is temporarily sealed to the surface of a pervious pavement. After pre-wetting the test location, a given mass of water is introduced into the ring and the time for the water to infiltrate the pavement is recorded. The infiltration rate is calculated.

2. ASTM C1701 may be conducted after a test panel has hardened to establish if the infiltration meets expectations.

3. ASTM C1701 can be conducted on a pervious pavement at any time to establish the infiltration rate. Typically, a reduction of 25% triggers maintenance activities.

4. ASTM C1701 can be done after curing to establish a baseline for future tests.

5. ASTM C1701 is not a pass/fail test. It is a subjective test, but it is recommended that infiltration rates be between 250 to 750 in./hr., with no value above 1,000 in./hr.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning and Protection

1. After paving, clear surfaces of excess asphaltic concrete and all foreign matter.
2. Cover openings of drainage structures until permanent covers are placed.
3. No vehicular traffic shall be permitted on the pavement until curing is complete (7 days) and no truck traffic shall be permitted for at least 14 days. No off-road construction traffic shall access the asphalt at any time.
4. Ensure that no debris or dirt are deposited on the porous asphalt pavement surface.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Brick Pavers
2. Granite slab paving
3. Sand or mortar setting beds, concrete bases and select fill base courses
4. Edging and all incidentals required for stone paving.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

C. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 31 23 23 - Fill

B. Section 03 30 00 - Cast-in-Place Concrete

1.04 REFERENCES

A. ASTM C97 - Standard Test Methods for Absorption & Bulk Specific Gravity of Dimension Stone

B. ASTM C99 - Standard Test Method for Modulus of Rupture of Dimension Stone

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

D. ASTM C150 - Standard Specification for Portland Cement

E. ASTM C170 - Standard Test Method for Compressive Strength of Dimension Stone

F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes

G. ASTM C270 - Standard Specification for Mortar for Unit Masonry

H. ASTM C615 - Standard Specification for Granite Dimension Stone

1.05 DESCRIPTION

A. Sustainable Design Requirements

1. Regional Materials: Pavers shall be manufactured within 500 miles of Project site.

B. Project-specific system design requirements will be provided in the Contract, if necessary, to supplement requirements given herein or in the Contract Drawings.

1.06 QUALITY ASSURANCE

A. Obtain each type of stone from a single quarry with resources to provide materials of consistent appearance and physical properties, and the capacity to cut finish, and supply stonework without delaying the progress of the Work.

B. Installation of all stonework shall be performed only by a firm specializing in such construction, using skilled workers.

C. Stone items noted herein shall be installed only in the presence of the Engineer. Contractor shall schedule and coordinate installation of such items with Engineer.

D. Sources are provided for all stone items specified herein.

E. Contractor may propose alternate sources for these stone items for approval.

1. Provide verification of conformance to specified requirements.

2. Provide stone samples and photographs showing proposed stone.

3. Provide full location and contact information for quarry.

F. Certain stone items as noted herein will be pre-selected. Alternate sources will not be considered for these items.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and manufacturer's technical information for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Mortar coloring pigments.

2. Anchors, dowels and other attachments or fasteners as required.

B. Shop Drawings shall include dimensioned locations of all anchors, for the following items:

1. Brick paving, showing range of typical sizes

2. Granite slab paving, showing typical sizes

C. Stone Samples: Submit stone samples for each different stone type and finish as specified, consisting of stones not less than 6 inches by 6 inches by 1 inch thick. Clearly mark samples to show finished face. Submit to show texture, and complete range of color variation for each type. Samples of stone with color variations shall be submitted with proportion of variation expected for use on the Project. Sample submittals will be reviewed for color, texture and pattern only. Compliance with all other requirements is the responsibility of the Contractor.

1. Brick Paver: Contractor shall verify and match existing pavers.

2. Charcoal Grey Granite: Split faced finish or full size samples of used granite block

3. Misty Grey Granite: Thermal finish

D. Mortar Samples: Submit samples of colored mortar for exposed joints.

1. Provide a minimum of three samples for each stone type.

2. Provide additional samples as required by Engineer, until acceptable sample is approved.

E. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Regional Materials. Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

c. Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. For assemblies, include the percentage by weight that is considered regional.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project site in undamaged condition. Store and handle stone and related materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, chipping, or other causes.

B. Do not use pinch or wrecking bars. Lift with wide-belt-type slings where possible. Do not use wire rope or ropes containing tar or other substances which might cause staining. If required to move stone, use wood rollers with cushions at end of wood slides.

C. Store stone on wood skids or pallets, covered with non-staining, waterproof membrane. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Allow air circulation around stones. Store cementitious materials off the ground, under cover and in a dry location.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers will be named, if necessary, in the Contract.

2.02 MATERIALS / EQUIPMENT

A. Stone - General

1. All stone shall conform to the following requirements:

   a. Stone shall be hard, durable and free from seams, cracks or other defects.

   b. Conform to the requirements of ASTM C615 for strength.

   c. Stone shall be of color and tone within range of approved samples.

2. All granite shall conform to the following additional requirements:

   a. Absorption by weight: 0.4% maximum - ASTM C97.

   b. Density: 160 lbs/cu.ft. Minimum - ASTM C97.

   c. Compressive Strength: 19,000 psi minimum - ASTM C170.

   d. Modulus of Rupture: 1,500 psi average - ASTM C99.

B. Brick Pavers

1. Brick Paver: Unit clay paver shall conform to the requirements of American Society of Testing Materials specification standards C902, Class SX, Type 1, Application- PX. The units shall be standard 4" x 8", having dimensions of 2 1/4" x 4" x 8"(+/- 1/16”), square edges, a 12,500 psi minimum compressive strength, less than 6% cold water absorption. Must pass cycle test C67 Freeze/ Thaw and CSA-a231.2 freeze thaw test in saline solution without the use of sealers applied to the paver. Paver color shall conform to “Pathway Autumn Blend” (552492CB) brick pavers as manufactured by Pine Hall Brick Co., Inc., Winston-Salem, North Carolina and distributed by Church Brick Co., Bordentown, NJ 609-298-0090 or approved equal.
    a. Pavers shall be laid in the existing pattern.
    b. New pavers shall be homogeneously added into existing brick.

C. Granite Slab Paving

1. Granite shall be obtained from a single source
2. Stone finishes shall be as follows:
    a. Top: Thermal finish.
    b. Sides: Split faced finish.
    c. Bottom: Split faced or sawn finish.
3. Stone sizes shall be as follows:
    a. Thickness: consistent thickness of 8 inches, with a tolerance of 1/4 inch, or as shown on the Contract Drawings.
    b. Width: consistent width, as shown on the Contract Drawings.
    c. Length: varied length, as shown on the Contract Drawings.

D. Cut Granite Paving

1. Granite shall be obtained from a single source.
2. Stone finishes shall be as follows:
    a. Top: Thermal finish
    b. Sides: Sawn finish
    c. Bottom: Sawn finish
3. Stone sizes shall be as follows:
    a. Thickness: consistent thickness of 3 inches, with a tolerance of 1/4 inch, or as shown on the Contract Drawings.
    b. Cut to dimensions as shown on the Contract Drawings. Field verify all angles, penetrations and other site conditions prior to cutting. All radial cuts shall be made to true radii.

E. Mortar

1. Setting Bed Mortar: Mortar at all setting beds shall comply with ASTM C270, Type K, and shall consist of:
   a. 1 part Portland Cement
   b. 1 parts lime
   c. 6 parts sand
2. Joint Mortar: Mortar at all visible joints shall comply with ASTM C270, Type K, and shall consist of:
   a. 1 part Portland Cement
   b. 1 parts lime
   c. 6 parts sand
   d. Coloring pigment added to produce joint color approved by Engineer.
3. Mortar products shall comply with the following requirements:
   a. Portland Cement: ASTM C150, Type I. Provide gray cement.
   b. Hydrated Lime: ASTM C207, Type S.
   c. Sand: ASTM C144.
   d. Water: Clean, non-alkaline, and potable.
4. Mortar Coloring: Natural iron oxides or chromium oxides pigments, consisting of the following:
   a. "True Tone Mortar Colors"; Davis Colors, a subsidiary of Rockwood Industries, Los Angeles, CA.
   b. "Sonobrite"; Sonneborn B. P. Div.; Rexnord Chemical Products, Inc., Miami, FL.
   c. Or approved equal

F. Sand

1. Sand for setting bed shall consist of clean, hard, durable, uncoated particles, conforming to the following:

Sieve Size	Percent Passing by Weight
1/4"	100
No. 50	0 - 35
No. 100	0 - 10

G. Pre-Emergent Herbicide

1. Pre-emergent herbicide shall be: Treflan 5G, EPA # 62719-98-3878, in granular form, or approved equal with written approval from NYCDEP prior to use.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Stone Fabrication

1. Fabricate stonework to sizes, shapes and finishes shown on the Contract Drawings. Where field cutting of stones is required, use power saws to cut stones. For exposed edges, produce edges which are cut straight and true.

2. Cut and drill sinkages and holes in stones for anchors, fasteners, supports and lifting devices as shown on the Contract Drawings or as required to set stonework securely in place.

3. Clean all sawn faces of stones to remove rust stains and iron particles.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Contractor shall examine all surfaces to receive stonework, and correct all conditions which are not in compliance with the requirements specified herein, or which are unsatisfactory in any way. It shall be the responsibility of the Contractor to ensure that all footings, and all subgrades, bases and surfaces to receive stonework, are clean, level and adequately prepared.

B. Clean all surfaces of stones which have become dirty or stained prior to setting.

1. Remove all soil, stains and foreign materials.

2. Clean stones by thoroughly scrubbing stones with fiber brushes followed by a thorough drenching with clear water.

3. Use only mild cleaning compounds that contain no caustic materials or abrasives.

3.02 INSTALLATION

A. Setting Stone - General

1. Selected items as specified herein shall be installed only in the presence of the Engineer. Contractor shall coordinate installation schedule of such Work with Engineer.

2. Tolerances

a. Variation of slope and grade: Check slope and grade of installed paving units with a 12-foot straight-edge. Surface shall be true to grades and slopes indicated within 1/8 inch in 10 feet.

b. Offset at joints: Not to exceed 1/16 inch.

3. Mortar Cement Setting Bed

a. Place and shape mortar setting bed to full depth, typically 3/4 inch minimum, or as shown on the Contract Drawings. Screed setting mortar level.

b. The area of bedding course placed in any work day shall be scheduled so that no bedding course remains at the end of the day without a paver course. After final shaping, the bedding course shall not be disturbed prior to laying paver units.

c. Install anchors, supports, fasteners, and other attachments shown, or necessary to secure stone in place. Shim and adjust accessories as required for proper setting of stone. Completely fill holes, slots and other sinkages for anchors, dowels, fasteners and supports with mortar during setting of stone.

4. Setting of Stone Paving Units

a. Pattern: Lay in patterns indicated on Contract Drawings. Joints shall align or be on centerlines as indicated on Contract Drawings. Field check all dimensions.

b. When ready for setting, all paving units shall be clean and free from stain, dirt, or dust. If necessary, scrub face with mild soap and clean water applied with stiff fiber brushes. Rinse well with clean water.

c. Stone pavers shall be cut to fit around items penetrating surfaces. Cutting shall be performed with a high-speed masonry saw producing squared, clean, and sharp edges.

d. The surface edge of one paver shall be level with the next adjacent pavers so that no voids, rocking motions, or tripping hazards are encountered. In addition, comply with specified tolerances.

e. Any unit having a hollow sound after being laid shall be reset to provide solid backing.

f. Maintain exposed faces of paving units free of setting bed and/or joint mortar. Any mortar or grout which gets on exposed faces shall be immediately removed with sponge and clean water.

5. Mortar Joints

a. Stone paving units shall be kept perfectly clean throughout installation, and joints between shall be raked out to a depth of ½" for joint mortar.

b. After all paving and other surfacing materials have been set and setting bed is thoroughly cured (minimum 36 hours), brush joints clean.

c. Thoroughly wet raked out portion of joint, and then fill solid with colored mortar to match approved sample.

d. After initial set of mortar joints shall be finished by tooling joint with a non-staining jointer to produce a dense, slightly concave surface, flush with paving unit surface.

6. Expansion Joints

a. Provide expansion joints where paver units abut other constructions and at all locations shown on the Contract Drawings. Do not fill with mortar.

b. Install continuous strips of preformed joint filler. The joint filler material shall be brought to within 3/4-inch of the finished surface of the concrete.

c. After curing the joint shall be filled with approved backer rod and two-part urethane sealant in approved color.

d. Sealant shall be flush with finished surface of stone.

7. Curing

a. After installation all joints shall be cured for a minimum of 5 days, by covering with curing paper or other approved material.

B. Clay Brick Pavers On Sand Bed

1. Preparation

a. The excavation shall be completely cleared of all debris and undesirable material.

b. The excavation shall not be muddy, waterlogged, or otherwise unsatisfactory.

c. If the excavation becomes rutted or displaced, due to any cause whatsoever, the Contractor shall regrade same without additional payment.

2. Fine grade all areas to receive paving and compact subgrade evenly to 95 percent modified proctor, in accordance with the requirements of Section 31 23 23 - Fill.

a. Vibrate pavers into leveling course with a low amplitude plate vibration capable of a 3,500 to 5,000 pound compaction force. Perform at least 3 passes across paving with vibrator. Do not place vibrator directly on pavers. Use plywood between vibrator and pavers.

b. Spread dry polymeric sand and fill joints immediately after vibrating pavers into leveling course. Brush and vibrate (with rubber mat fitted plate) sand joints until completely filled, then remove surplus sand.

c. All hollows and depressions which develop under rolling shall be filled with controlled fill or select fill, and re-compacted.

3. Select fill base course material shall be evenly spread on the prepared excavation in the location shown on the plans, in 4-inch layers, each layer rolled while wet with a 10-ton roller.

   a. Adjust base course elevation as required so that when pavers are placed, the top surface of the pavers will be at the required finished grade.

4. Spread pre-emergent weed killer over compacted base course, at a rate of 5 lbs. per 1,000 square feet, using equipment as recommended by the manufacturer to ensure a uniform application after written approval from NYCDEP.

5. Base course shall be wetted immediately before placement of paving.

6. Edging: Install edging against side of base course material as shown on the Drawings, so that the top of edging will be flush with top surface of pavers.

   a. Verify the completion and correct alignment of all other edgings specified elsewhere, prior to installation of pavers.

7. Filter Fabric: Install filter fabric over select fill base, as shown on the Drawings.

8. Sand Setting Bed

   a. Place sand bed material over filter fabric.

   b. Compact sand bed prior to paver installation. Calculate degree of compaction and adjust bed with straight edge to bring the pavers, when laid, to proper grade.

   c. Fill low areas in setting bed with additional sand to produce smooth, firm and even setting bed.

   d. Install setting bed only over area which will be covered by pavers during the same day.

9. Paver Installation

   a. Place the pavers by hand in straight courses, maintaining a uniform top surface.

   b. Good alignment must be kept, and the pattern shall match the pre-construction paver pattern.

   c. Where cutting is required, use a diamond blade masonry saw.

d. As soon as a sufficiently large area of pavers has been installed, compact pavers into setting bed using a hand-tamper.

e. Following compaction, brush clean sand over pavers to completely fill all voids.

3.03 FIELD TESTING / QUALITY CONTROL

A. No stonework or mortar shall be installed when temperatures are at or below 40 degrees F, or during rain, sleet, or snow.

B. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen or thawing subgrade or base course. Remove and replace Work damaged by frost or freezing.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjustments

1. Replace or repair defective, broken or damaged stone units or system components, including but not limited to the following defects:

a. Stones and joints not matching approved samples

b. Broken, chipped, stained, or otherwise damaged stones

c. Defective setting beds

d. Unfilled or defective joints

e. Uneven settling, or other evidence of improper bedding or alignment

f. All other defects as directed by the Engineer.

B. Protection

1. Protect newly installed pavers with panels of plywood on which the installer stands.

a. Plywood can be advanced as work progresses. Plywood protection must be kept in areas which will be subjected to continued movement of materials and equipment.

b. Cover top of paving and other stonework with non-staining waterproof sheeting at end of each day's work. Covers shall be securely held in place.

2. Cover partially completed paving when Work is not in progress.

3. Prevent staining of stone/paver from mortar, or other sources.

a. Immediately remove such materials from stone without damage to latter.

b. Protect bases of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

4. The Contractor shall maintain all stonework during the life of this Contract until Final Acceptance of the work, and shall repair and replace all work that is disturbed, damaged, or destroyed without additional payment.

C. Clean-Up

1. After all mortar is thoroughly set, clean all stonework to remove all mortar and stains, using mild non-corrosive materials and brushes. All surrounding paving materials or other structures shall be cleaned of all mortar and stains.

2. After completion of the work, the Contractor shall remove all debris and excess materials, restore all damaged areas and leave the area in a clean state acceptable to the Engineer.

END OF SECTION

SECTION 32 16 13 - CURBS AND GUTTERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, and equipment required to provide concrete curbs, headers, and sidewalks, as shown, specified and required.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Implementation	5
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 10 00 - Concrete Forming and Accessories

B. Section 03 30 00 - Cast-in-Place Concrete

C. Section 03 35 00 - Concrete Finishing

D. Section 05 50 00 - Metal Fabrications

E. Section 09 91 00 - Painting

F. Section 31 23 16 - Excavation

G. Section 31 23 23 - Fill

1.04 REFERENCES

A. ASTM A36 - Carbon Structural Steel

B. New York City Department of Transportation (NYCDOT) Standard Highway Specifications (NYCDOT Specifications)

C. NYCDOT Standard Details of Construction

D. NYCDOT Street Design Manual

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

2. Global Warming Potential (GWP) – Measure of how much a specific greenhouse gas contributes to global warming compared to carbon dioxide (CO2) over a given time period, usually 100 years.

1.05 DESCRIPTION

A. Design Requirements

1. Concrete curbs, headers, and sidewalks which are outside the building line of the site and under jurisdiction of other City agencies, even though constructed as part of this Contract, shall be constructed in accordance with the Rules and Regulations, Standard Details and Standard Specifications of the governing agency in effect at the time of the award of this Contract and as specified and defined in the Contract Drawings.

2. Unless otherwise specified and defined in the Contract Drawings, concrete for curbs, headers, and sidewalks which are inside the building line of the site and not under the jurisdiction of other City agencies shall meet the following requirements:

a. 3500 psi minimum 28-day compressive strength.

b. Utilize type II Cement and contain aggregate conforming to ASTM #57.

c. Water-cement ratio not exceeding 0.44 for normal weight structural concrete.

d. Slump values of 1-1/2 inch minimum to 4 inch maximum.

e. Desired air-entrainment of 6.5%, with an allowable range of +/- 1.5%.

f. Concrete shall be proportioned, mixed, placed, cured and protected in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

B. Sustainability Performance Requirements

C. All Concrete mix designs shall conform with the Sustainability requirements of Section 03 30 00 - Cast-in-Place Concrete

D. Submit an EPD for ready-mix concrete, for approval by the Engineer.

1. If an EPD for a concrete mix is available, the value given for the GWP of a mix will be the A1- A3 GWP listed on the EPD.

a. Effective January 1, 2025, ready-mix concrete supplied to the construction site shall be delivered with a product-specific EPD. Failure to submit an EPD will exclude the mix from being used.

b. EPDs shall be submitted using the project Web-Based Project Management Information System in accordance with Section 01 31 25 - Web-Based Project Management Information System. EPDs shall be submitted together with the relevant material submittal for approval by the Engineer.

2. If an EPD for ready-mix concrete is not available, prior to January 1, 2025:

a. Submit negative proof evidence that no product, plant or mix-specific EPD could be sourced, for approval by the Engineer.

b. Calculate the GWP of the ready-mix concrete using the Greenhouse Gas (GHG) Emission Coefficients and the GWP formula shown in the table and equation below.

Material	GHG Emission Coefficient (lb./lb.)
Portland cement (PC)	1.04823
Portland Limestone cement (PLC)	0.95100
Portland Slag cement (1S)	0.73439
Calcium Sulfoaluminate (CSA)	0.73360
Fly Ash (FA)	0.32847
Carbonated Fly Ash (CFA)	0.27900
Granulated Blast Furnace Slag (GBFS)	0.26363
Ground Glass Pozzolan (GGP)	0.05560
Crushed Coarse Aggregate (CA)	0.00372
Fine Aggregate and Gravel (SG)	0.00258

Recycled Aggregate (RCA)	0.00120
Lightweight Aggregate (LWA)	0.30000

GWP = (1.04823 * mPC) + (0.95100 * mPLC) + (0.73439 * m1S)
+ (0.73360 * mCSA) + (0.32847 * mFA) + (0.27900 * mCFA)
+ (0.26363 * mGBFS) + (0.05560 * mGGP) + (0.00372 * mCA)
+ (0.00258 * mSG) + (0.00120 * mRCA) + (0.30000 *mLWA)

Where:
GWP is the A1 Global Warming Potential in pounds per cubic yard.
m is the mass of each constituent in the concrete mix in pounds.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Those required in Section 03 30 00 - Cast-in-Place Concrete.
2. Marked-up drawings and Shop Drawings including shop and field test reports of concrete samples tested in an approved laboratory.
3. Concrete sidewalk and curb layouts showing scoring and joint layouts, including joint and sealant materials to be incorporated.

B. All mix designs shall be accompanied by an Environmental Product Declaration (EPD) in compliance with Article 2.03.

1. If an EPD is not available prior to January 1, 2025, submit the negative proof and Global Warming Potential (GWP) calculations for each mix design in accordance with Article 2.05.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Coarse aggregate, unless otherwise specified, shall conform to the requirements of Section 03 30 00 - Cast-in-Place Concrete.

B. Concrete shall be air-entrained in accordance with Section 03 30 00 - Cast-in-Place Concrete.

C. Material for foundation of curbs, headers, and sidewalks shall consist Size No. 3 broken stone or gravel complying with the requirements of Section 2.02, NYCDOT Specifications, 100 percent of which passes a 2-1/2-inch square sieve; or other approved broken concrete, 100 percent of which passes a 2-1/2-inch square sieve; or other approved granular material containing not more than 5 percent material passing a No. 200 mesh sieve and not more than 5 percent retained on a 2-inch square sieve.

D. Unless otherwise specified and defined in the Contract Drawings preformed expansion joint filler shall be Type IV as described in Section 2.15 of the NYCDOT Specifications.

E. Joint sealing compound for horizontal joints shall be Type 2 cold application sealer as described in Section 2.22 of the NYCDOT Specifications.

F. Structural steel shall be ASTM A36 and Section 05 50 00 – Metal Fabrications.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Concrete shall be tested and evaluated for strength and acceptance in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Sidewalk Installation

1. Concrete sidewalk shall be of the width shown or otherwise specified and shall be laid on 6 inches thick compacted broken stone base, unless otherwise specified or shown on the Contract Drawings.

2. Sidewalk shall consist of a single course of concrete 4 or 7 inches thick, as shown on the Contract Drawings.

3. Excavation and subgrade preparation shall be in accordance with the requirements of Section 31 23 16 - Excavation. All existing material within the required 6 inches of foundation shall be removed in its entirety. Additional depth of foundation material for special conditions shall be placed as required by the Engineer.

4. Materials: Foundation material shall be placed on the prepared subgrade and thoroughly compacted into a course not less than 6 inches thick. The top surface shall be parallel to the finished grade and at a distance below the grade equal to the specified thickness of concrete.

5. Forms: Forms shall be in accordance with Section 03 10 00 – Concrete Forming and Accessories.

6. Slabs: Concrete sidewalk shall be built in approximately 20-foot lengths between expansion joints. The sidewalk shall be separated from adjoining structures by expansion joints. When directed, these joints shall be filled with dry sand. Expansion joints in sidewalk shall coincide with expansion joints in curb. Tooled control joints not less than 1/2 inch in depth shall be provided where at five-foot intervals unless otherwise shown on the Contract Drawings.

7. Expansion Joints: Transverse expansion joints shall be 1/2 inch in width and shall be filled with preformed joint filler to within 1 inch of the sidewalk surface. The top 1 inch shall be sealed with Type 2 cold application sealer complying with the requirements of Section 2.22 of the NYCDOT Specifications.

8. The foundation material shall be wetted immediately before concrete is placed. The concrete shall be placed within the forms and thoroughly tamped until the surface is at the finished grade.

9. The top surfaces shall be finished in accordance with Section 03 35 00 – Concrete Finishing. Each rectangular slab shall have all edges neatly rounded with proper tools and be bounded on all sides by a troweled border about 1 inch in width. Surface texture of pedestrian ramps shall be transverse grooves, 1/2 inch wide by 1/4 inch deep on 2-inch centers.

10. Backfilling shall follow the removal of forms as soon as practicable and, unless otherwise permitted, shall be of clean earth, satisfactorily compacted. Backfilling shall conforming to the requirements of Section 31 23 23 - Fill.

11. Concrete sidewalk shall be cured according to Section 03 30 00 - Cast-in-Place Concrete.

12. All material types of sidewalk, such as unpigmented, pigmented, bluestone or pavers, and details are outlined in the NYCDOT Street Design Manual.

B. Curb and Header Installation

1. Concrete curbs, headers, and steel faced concrete curbs, except as otherwise detailed and specified, shall be constructed in accordance with the applicable provisions of Sections 4.08 and 4.09, NYCDOT Standard Highway Specifications, except that concrete strength shall conform to Class 35 as indicated in Section 03 30 00 - Cast-in-Place Concrete. Depressed curbs shall be provided where specified or shown on the Contract Drawings.

2. Steel street curbs shall conform to ASTM A36 of the size indicated on the Contract Drawings. The length of straight runs shall be not less than 10 feet nor more than 20 feet. Curved curb angles shall be bent to the radius indicated, and provided with a straight tangent at each end, 3 feet in length. Special steel curb angles of approved type shall be provided at drop curbs. Where the length of the special drop curb exceeds 20 feet, it shall be spliced with an approved type butt welded joint. Anchors shall be welded to all steel curbing. The steel curbs shall be placed within the forms, upon suitable chairs, to the proper lines and grades. The joints between units of curbing shall be 1/8 inch. All surfaces of steel curbing, including anchors, shall be thoroughly cleaned of all rust, oil, grease, scale or other foreign matter before concrete is placed. All surfaces of steel curbing which are to remain exposed in the finished work shall be painted in the shop in accordance with Section 09 91 00 - Painting. Finish coats shall be gray in color.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 32 31 19 – DECORATIVE METAL AND WOOD FENCES AND GATES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for decorative fences and gates. Decorative fences and gates shall conform to the requirements specified herein, and in the Contract; and as shown on the Contract Drawings. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all decorative fences and gates Work.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	10
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 06 00.01 - Schedules for Stainless Steel Work

B. Section 05 05 23.02 - Miscellaneous Metal Fastenings

C.	Section 05 05 23.01	-	Welding
D.	Section 05 05 13.01	-	Galvanizing
E.	Section 05 12 00	-	Structural Steel Framing
F.	Section 09 91 00	-	Painting

1.04 REFERENCES

A.	ASTM A276	-	Stainless Steel Bars and Shapes
B.	ASTM A554	-	Welded Stainless Steel Mechanical Tubing
C.	ASTM A666	-	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
D.	ASTM F593	-	Stainless Steel Bolts, Hex Cap Screws and Studs
E.	ASTM F594	-	Stainless Steel Nuts
F.	AWS A5.12	-	Tungsten and Tungsten Alloy Electrodes for Arc Welding and Cutting
G.	AWS	-	Standard Codes for Arc and Gas Welding in Building Construction

1.05 DESCRIPTION

A. Maintain the visual design concept shown, and the technical requirements specified, including modules, profiles, alignment of components and requirements for finish.

B. Thermal Control: Provide adequate expansion joints within the fabricated system which allows for all thermal expansion and contraction caused by a material temperature range of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing a 1/4 inch wide joint at 70°F which accommodates a movement of 150 percent of the calculated amount of movement for the specified temperature range.

C. Provide expansion joints in decorative fencing Work where systems cross expansion joints in structure.

D. Configuration of all decorative fences and gates shall be as shown on the Contract Drawings. All details shown on the Contract Drawings are typical; similar details apply to similar conditions, unless specifically noted otherwise on the Contract Drawings. Verify dimensions at the site without causing delay in the Work.

E. Fasteners and Supports:

1. When the size, length or load carrying capacity of an anchor bolt, concrete anchor or concrete insert is not shown on the Contract Drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four.

2. Sizes shown on the Contract Drawings shall be considered minimum. Increase size to comply with design loadings and minimum safety factor specified.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Engage a single fabricator, with undivided responsibility for detailing and performance of the decorative fences and gates of a given material.

2. Engage a firm which can show five years previous successful experience in detailing and fabrication of decorative fences and gates of scope and type similar to the required work.

3. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests shall not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Installer Qualifications:

1. Engage a single installer skilled, trained and with documented successful experience in the installation of decorative fences and gates and with specific skill and successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualification to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owner, architects or engineers responsible for projects.

b. Approximate contract cost of the decorative fences and gates.

c. Amount of area installed.

C. Source Quality Control:

1. Obtain all ornamental fences and gates components and accessories from the same manufacturer.

2. Provide qualified welding processes and welding operators in accordance with AWS “Structural Welding Code” D1.1, Section 5, Qualification.

3. Provide certification that all welders employed on, or to be employed for, the fabrication of the ornamental fences and gates have satisfactorily passed AWS qualification tests within the previous twelve months. Contractor shall ensure that all certifications are kept current.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittal shall include, but not limited to:

1. Full size fence section mockup and gate section with all associated connections, and mounting brackets all with specified controlled uniform finish.

2. Samples will be reviewed by Engineer for color, finish, joinery appearance and workmanship only. Compliance with all other requirements is the responsibility of Contractor.

B. Shop Drawings:

1. Drawings for the fabrication and erection of decorative fences and gates with sizes of members, components and anchorage devices, all based on specified requirements. Include copies of manufacturer's specifications, standard and custom detail drawings and installation instructions for decorative fences and gates. Include all plans and elevations identifying the location of all decorative fences and gates, and all expansion joints.

2. Profiles of decorative fences and gates components, and the details of forming, jointing, sections, connection, internal supports, trim, and accessories. Show details drawn at 1-1/2 inch scale.

3. All calculations for complete structural analysis of the systems including calculations showing compliance with the performance criteria specified.

4. Manufacturer’s catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.

C. Certificates:

1. Copies of material purchase receipts, for this job, signed by a certified and licensed Notary Public, verifying that material purchased for the Work complies with material designations specified as confirmed by approved Shop Drawing Certification of welders and welding procedures shall be submitted as specified.

2. Installer qualifications.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver decorative fences and gates and all accessories dry and undamaged, with manufacturer's protective coating intact, bearing original intact factory labels.

2. Decorative fences and gates which are damaged during delivery or while being unloaded shall not be stored on site. Remove such units from Site and replace units with new, undamaged material.

B. Storage of Materials:

1. Store decorative fences and gates and accessory materials under tarpaulin covers and in an area protected from dirt, damage, weather and from the construction activities of all Contractors. Do not store outside or allow items to become wet or soiled in any way while on Site.

2. Do not store in contact with concrete, earth or other materials that might cause corrosion, staining, scratching or damage to finish. Do not install system components which become dented, scratched or damaged in any way. Remove such components from site and replace with new, undamaged material.

C. Handling of Materials:

1. Do not subject decorative fences and gates and accessory materials to bending or stress. Do not carry or transport panels in the horizontal (flat) position. Hold panels upright on edge when handling.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Product and Manufacturer - provide one of the following for grout:

1. Euco N-S as manufactured by The Euclid Chemical Company, East Brunswick, NJ;

2. Masterflow 713 as manufactured by Master Builders Company, Cleveland, OH;

3. Or approved equal.

B. Product and Manufacturer - provide one of the following for Powder Coating:

1. Polyester Z series AG Metallic Silver as per Pro-tech, Montreal, QC

2. Anti-Graffiti Gray Metallic as per Alpha Coating Tech LLC., Chicago, IL

3. Or approved equal.

C. Product and Manufacturer - provide one of the following for Anti-graffiti coating:

1. Clear Coat 1K Siloxane as per Sherwin Williams, Cleveland, OH
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Wooden gate shall be made of redwood. Wood members shall not have holes or cracks, or appreciable knots or discoloring.

B. Wooden gate hardware will be powder coated galvanized steel, in a color chosen by the architect from the manufacturer's full range.

C. Provide posts, pickets and rails of wrought ironin the sizes shown.

D. Brackets, Flanges, and Inserts: Provide ASTM A666, Type 316L stainless steel brackets, flanges and inserts. Furnish stainless steel inserts as required for anchorage to concrete or masonry. Components shall be selected by Engineer from manufacturer's standard and custom components. Components shall be in accordance with manufacturer's recommendations and as acceptable to Engineer as shown on approved Shop Drawings.

E. Accessory and Miscellaneous Materials: Provide all accessory items and system components of ASTM A666, Type 316 stainless steel, finished to match decorative fences and gates.

F. Concrete and Masonry Anchors: Concrete and masonry anchors shall be as specified in Section 05 05 23.02 – Miscellaneous Metal Fastenings.

1. Anchors shall be of stainless steel Type 316 and a minimum size of 1/2 inch diameter.

G. Non-Shrink, Non-Metallic Grout: Pre-mixed non-staining cementitious grout requiring only the addition of water.

H. Bolting Materials: As specified in Section 05 05 23.02 – Miscellaneous Metal Fastenings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Fabrication

1. Provide decorative fences and gates completely factory fabricated using fabrication techniques recommended for stainless steel. Use tools and fabrication equipment dedicated only to the fabrication of Type 300 series stainless steels to completely eliminate ferrous contamination.

2. Field Measurement: Take field measurements where required, prior to the preparation of Shop Drawings and fabrication, to ensure proper fitting of the Work.

3. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

4. Welding

   a. Welding shall comply with the requirements of AWS, NYBC and BSA.

   b. Field welding shall not be permitted unless approved by Engineer.

   c. All welding shall be performed with Inert Gas Tungsten Arc Welding using Direct Current, Straight Polarity. The non-consumable electrode shall be 1/16-inch diameter, 2 percent thoriated tungsten electrode and have a point ground on the end similar to a pencil point. The welding current shall be between 70 and 100 amperes. The shielding gas shall be argon, helium or a combination of both with a minimum flow of 15 cubic feet per hour. Filler metal shall be Type 316L, stainless steel.

   d. All welds shall be ground smooth, then finished to blend with the stainless steel members and have a comparable surface finish.

   e. The completed decorative fences and gates shall be provided with ANSI No. 4 Satin (180 grit) finish.

5. Weep Holes:

   a. Provide 15/64 inch diameter weep holes at the lowest point on all hollow pickets and posts and along the bottom side of hollow horizontal members.

   b. Provide pressure relief holes at closed ends of hollow members.

B. Assembling

1. Fencing shall be assembled as indicated in the Contract Drawings or as per Manufacturers recommendations

C. Metal Coatings/Finishes

1. Finishes for Stainless Steel

   a. All exposed members shall have ANSI No. 4 Satin (180 grit) finish.

2. Finishes for Steel

   a. All exposed members must be galvanizedas per Section 05 05 13.01- Galvanizing and shall be done prior to powder coating.

   a. All exposed fence and Gate members shall be Powder Coated finish. Type and color shall be <u>Polyester Z series AG Metallic Silver as per Pro-tech or approved equal</u>.

      1) Cleaning and chemical per-treatment: this application is required for all fencing panels, posts and gates prior to application of the specified coating system.

2) New zinc surfaces are to be examined for flux residues, light roll forming oils and foreign matter are to be removed prior to pre-treatment for powder coating.

3) Surfaces that show white storage stain (white rust) or other corrosion evidence, must be cleaned, degreased and per-treated for optimal performance. White rust can lead to adhesion problems or out-gassing of the powder coating. Silicone based anti-spatters are not to be used as they may lead to de-wetting of the powder.

4) Powder application must occur within in 24 hours of substrate pre-treatment.

5) Pre-treatment system are to be maintained and tested in accordance with the pretreatment supplier's recommendations.

D. Final Coating (Anti-Graffiti)

1. Applied an anti-graffiti coating on all members of the fence and gates. The anti-graffiti coating shall be Protective Marine Coating type. Color shall be Clear Coat 1K Siloxane as per Sherwin Williams or approved equal.

E. Wood Coating/Finish

1. The redwood gate will be finished with semi-transparent UV resistant water repellant sealing stain.

F. Hardware for Wooden Gates.

1. Hinges: strap hinges shall be bolted completely through the wooden gate, 3 hinges per leaf. Hinges shall be powder coated galvanized steel, in a color chosen by the architect from the manufacturer’s full range. The strap hinges will be sized and rated for the gate’s weight, and will be anchored per the manufacturer’s details to the existing and new brick pilasters to support the gate. The gate is replicating a historical element of the facility and the hinges will therefore need to fit with that historical appearance. Hinges shall allow sufficient swing for 9’-6” clear width between leaves of wooden gate along entire width. Hinges shall prevent wooden gate leaves from swinging far enough to touch the brick pilasters or trim.

2. Operation: the wooden gate shall be manually operated.

3. Ground sleeves: shall be galvanized for cane locks with the gate in closed position. Sleeves to be installed flush to road surface so no tripping hazard is present.

4. Cane locks: powder coated galvanized to match the hinges and latch, 3/8 inches minimum diameter. Shall be installed on the internal side of the wooden gates.

5. Latch: powder coated galvanized to match the hinges and cane locks. Size and type to suit gate size and type. Shall be installed on the internal side of the wooden gates.

G. Hardware for Swinging Gates

1. Hinges: all hinges shall be bolted through gate post. Top and bottom hinges are to be reverses: one (1) hinge faced downwards and one (1) hinge faced upwards to ensure gates cannot be removed. Hinges' size and material shall suit gate size and material. All swing gates to allow for 180 degrees opening. All single swing gates shall be self-closing.
2. Operation: all swing gates shall be manually operated
3. Ground sleeves: shall be galvanized for security drop bolt with the gate in opened and closed position. Sleeves be installed in concrete so no tripping hazard is present.
4. Security drop bolt: 3/8 inches minimum diameter. Shall be installed on the internal side of stile
5. Strike strap: shall be continuous, welded to gate post
6. Latch: size and type to suit gate size, operable from both sides of gate.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

1. Obtain all ornamental fences and gates components and accessories for fences and gates of the same material from the same manufacturer.
2. Provide qualified welding processes and welding operators in accordance with AWS “Structural Welding Code” D1.1, Section 5, Qualification.
3. Provide certification that all welders employed on, or to be employed for, the fabrication of the ornamental fences and gates have satisfactorily passed AWS qualification tests within the previous twelve months. Contractor shall ensure that all certifications are kept current.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall examine the alignment of the substrate and conditions under which the decorative fences and gates work is to be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.02 INSTALLATION

A. All cutting, drilling, fitting, and welding shall be done In Shop, not in Field. If it is found that there needs to be any cutting, drilling, fitting, and welding on site then it is the Contractors responsibility to provide a written explanation to the Engineer as to why this activity needs to be done in field, and wait for the Engineers approval of such activity.

B. Upon written approval by the Engineer, all such work shall be as follows:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade the surface of units, which have not been finished after fabrication, and are intended for field connections.

3. See Article 3.05 for Adjusting, Protecting, and Cleanup procedures and responsibilities.

3.03 FIELD TESTING / QUALITY CONTROL

A. The Contractor and Manufacture shall field test all gates and motors to ensure that all gate assembly systems are working together correctly.

B. Any malfunctions, and or design flaws that are witnessed during test shall be fixed immediately.

C. Any minor adjustments may be addressed in field with the approval of the Engineer.

D. All major adjustments that include dismantling and welding shall be done in the shop to prevent damaging the finished materials and to recoat materials that have been stripped of their coating.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Adjust fencing and gates prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction.

B. Protection

1. Protect cast-in-place sleeves and field-drilled holes from debris and water intrusion by use of temporary covers or removable foam inserts.

C. Cleanup

1. All material that has been affected by cutting, drilling, fitting, and welding, shall also comply with the below requirements.

2. Clean exposed surfaces of decorative fences and gates before leaving the site after completion of installation. Do not use abrasives or non-approved solvent cleaners. Test cleaning techniques on an un-used section of decorative fence or gate before employing cleaning technique in the Work.

    a. Remove all stains, dirt, grease and other substances by washing the decorative fences and gates thoroughly using clean water and soap. Rinse with clean water.

    b. Do not use acid cleaning solutions, steel wool or other harsh abrasives. If stains remain after washing, remove finish and restore in accordance with recommendations of the manufacturer.

3. Leave fencing system and gates, free from dents, burrs, scratches, holes and other blemishes. Refinish minor scratches to be indistinguishable from adjacent un-scarred areas. If, after refinishing and the Engineers inspection, damage remains visible when viewed from five feet away, or if finish of work has been altered to the point where it appears different from adjacent work, Contractor shall replace damaged work with new undamaged material at no additional expense to DEP.

4. At the completion of the work, clean or replace adjacent work, marred by the Work of this Section.

5. Remove all materials and debris and leave the Site in clean condition.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Planting as specified herein includes, but is not limited to, the following:

1. Furnishing and installing new trees, shrubs, grasses, and all other plant materials.
2. Furnishing and installing new seeded, hydro-seeded, and sodded areas.
3. Staking and guying of trees, only where shown on the Contract Drawings or as directed.
4. Furnishing and installing filter fabric and drainage gravel under planted areas, in areas as shown on the Contract Drawings.
5. Furnishing and installing mulch.
6. Protection and maintenance of all plant materials and the replacement of plantings as required until Substantial Completion.
7. Plant protection, maintenance and replacements during guarantee period.

B. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	12
3.03	Field Testing / Quality Control	16

3.04 Startup / Demonstration 21
3.05 Adjusting / Protection / Cleanup.....21

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 31 23 23 - Fill

B. Section 31 25 10 - Dust, Soil Erosion and Sediment Control

C. Section 32 90 05 - Soil Mixes

1.04 REFERENCES

A. AmericanHort

1. American Standard for Nursery Stock (ASNS), ANSI Z60.1, current edition

B. New York Flora Atlas (http://newyork.plantatlas.usf.edu/Default.aspx)

C. USDA Plant Database (http://plants.usda.gov/java/) & USDA Plant Hardiness Zone Map (http://planthardiness.ars.usda.gov/PHZMWeb/)

1.05 DESCRIPTION

A. The Contractor shall locate all required plant materials and be present for their inspection, as directed by the Engineer, at the nursery prior to transport or upon delivery of the materials on Site. Notify the Engineer at least 14 days in advance of the Contractor's desired inspection dates and locations. The Engineer may designate a DEP Bureau of Water Supply Restoration Specialist as the Engineer's representative.

B. Inspection at Nursery: All plants may be inspected and selected by the Engineer at the nursery for conformity to the requirements of the Contract. Whether plant materials are inspected or not at the nursery, the Contractor shall make all preselection arrangements required by the Engineer to ensure an efficient selection procedure. Approval of plant materials at the nursery shall not affect the rights to inspect or reject the materials upon delivery or later.

C. Inspection at Delivery On-Site: Notify the Engineer at least five (5) working days in advance of delivery of plants to the Site.

1. The Engineer will inspect all plants upon delivery to the Site.

2. Contractor shall schedule a time for on-site inspection prior to planting, and shall arrange for adequate labor and equipment on-site at the time of inspection to unload, open, and handle plants during inspection.

3. The Engineer may reject any plant material prior to or upon delivery to the Site.

   a. All plant material that is dead, dying or appears unhealthy will be rejected.

   b. All plant material that has been improperly maintained, dug, transported or handled in such a way as to impair its appearance or health will be rejected.

   c. All substitutions are subject to approval by DEP.

D. The Engineer will be the sole judge of the condition of the plants.

1. All material that is rejected on site shall be removed immediately from the Site, and replaced with new material selected or approved by the Engineer, at no additional cost to DEP.

E. Sustainable Design Requirements:

1. Regional Materials: Provide plant materials that were grown and harvested, or extracted, within 250 miles of the Site unless otherwise required in the Contract.

1.06 QUALITY ASSURANCE

A. Comply with all rules, regulations, laws and ordinances of local, state and federal authorities having jurisdiction. Provide labor, materials, equipment and services necessary for work to comply with such requirements at no additional cost to DEP.

B. Procure and pay for permits and licenses required for Work of this Section. Obtain all required permits in a timely manner to avoid delays to the Work.

C. Plant Quality

1. Provide plant material to meet or exceed applicable standards defined by American Standard for Nursery Stock (ANSI Z60.1, latest edition). including plant names, size and grading standards.

   a. Plants shall be typical of their species or variety with normal habits of growth, in accordance with ANSI Z60.1; sound, healthy and vigorous, well-branched and densely foliated when in leaf, with healthy well developed root systems; and free from disease, abrasions of the bark, insect pests, eggs or larvae.

   b. Plant species native to the Eastern United States shall be provided. Non-native species shall not be considered as substitutes for native species.

   c. Plants shall be true to species and, if as a variety or cultivar, said cultivar or variety shall be listed in The New York Flora Atlas (http://newyork.plantatlas.usf.edu/Default.aspx) to determine nativity.

d. Native plant material shall be derived from the local genotypes of the native plants specified to the greatest extent practicable. No plant material shall be collected or harvested from non-nursery areas.

e. Plants that have escaped cultivation, or have accidentally been introduced or naturalized into native habitats, shall not be considered native to the Eastern United States. Refer to USDA Plants Database (http://plants.usda.gov/java) for taxonomy and New York Flora Atlas to determine nativity.

D. Landscape Subcontractor

1. The Contractor shall provide evidence to the Engineer that the landscape subcontractor has experience in landscape work similar to the type and scale of work to be provided in this Project.

E. Finish Grade: Elevation of finished surface of soil.

F. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

G. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

H. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.07 SUBMITTALS

A. Submit a Statement of Qualifications for the landscape subcontractor, that shall consist of the following information:

1. Company name and address

2. Number of years in business under this name

3. Number of current full-time, part-time, and seasonal employees

4. Estimated number of employees intended for this Project

5. Current workload:

a. Name and address of current projects

b. Types and dollar amounts of work for which landscape subcontractor is responsible in each current project

c. Estimated completion date for each current project

6. References for three (3) projects completed within the last six (6) years, which are similar in scope to this Project, including the following information for each project:

a. Name and address of project

b. General description of work

c. Dollar amount of landscape work performed

d. Dates landscape work was started and completed

e. Verified contact information for at least one (1) representative of the owner or prime construction contractors in each projects:

1) Name,

2) Mailing address,

3) E-mail address, and

4) Telephone numbers (Office and Direct).

7. Contact information similar to above for at least one (1) representative of the Architect, Engineer, Landscape Architect, or other representative of the designer or construction manager for each project given as reference.

B. Samples: Submit samples of the following items:

1. Mulch: One (1) pound bag with manufacturer's certification of content

C. Growers/Nurseries: Contractor shall submit a list of proposed growers/nurseries prior to the commencement of any landscaping Work, with sufficient advance notice of at least 60 days or as stated in the Contract.

D. For nurseries, a copy of state inspection certificate for current year shall be submitted.

E. Materials/Certificates: Contractor shall submit a list of all materials and certificates specified in this Section prior to the commencement of any landscaping Work, with sufficient advance notice of at least 30 days or as stated in the Contract.

F. All necessary state, federal and other inspection certificates as may be required by law.

G. Product Data - Where applicable, the following product data shall be submitted:

1. Manufacturers' product information for filter fabric, showing conformance with the specified requirements.

2. Analysis of each seed or hydroseed mix to be used, showing percentage of each species, percentage of purity, weed content and germination of seed.

3. Identification of seed source and certification that all seed material is true to name, type, purity and other criteria in conformance with the Contract Documents .

4. Certified analysis for each treatment, amendment, and fertilizer material specified and as used, including weight for packaged material.

5. Manufacturers' product information for erosion control blankets or mats, including documentation that products are 100% biodegradable.

H. Documentation: The Contractor shall submit written documentation at least 30 days prior to scheduled start of planting that all plant material has been ordered.

I. Maintenance Program: Submit written schedule of maintenance operations proposed for the guarantee period. Schedule shall be in the form of a list of all proposed maintenance tasks, with dates showing when each maintenance task will be performed and its frequency of occurrence.

J. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Regional Materials. Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

K. Indicate the location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. For assemblies, include the percentage by weight that is considered regional.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in unopened bags or containers, each clearly bearing the name of the producer, the material composition, manufacturers' certified analysis, and the weight of the material.

B. Handle all plant material to prevent injury to trunks, branches and roots.

1. Do not bend or bind-tie trees in such manner as to damage bark, break branches or destroy natural shape.

2. Do not drop or thrown plant material during delivery. Unloading shall be performed with appropriate equipment.

C. Pack and ship all plant material to ensure arrival at site in good condition. Provide protective covering during transport and delivery.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. All new plant material shall be guaranteed for a period of 2 years after the date of Substantial Completion, unless otherwise required in the Contract.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable suppliers of planting materials shall be as indicated below.

1. Hardscrabble Farms Nursery, North Salem, NY (www.hardscrabblefarms.com);
2. Pinelands Nursery, Columbus, NJ (www.pinelandsnursery.com);
3. New England Wetland Plants, Inc., Amherst, MA (www.newp.com);
4. One Nature Nursery, Bloomingburg, NY (www.onenaturellc.com);
5. Ernst Conservation Seed, Meadville, PA (www.ernstseed.com);
6. Sylva Native Nursery & Seed Company, Glen Rock, PA (www.sylvanative.com);
7. Octoraro Native Plant Nursery, Kirkwood, PA (www.octoraro.com);
8. Northcreek Nurseries, Oxford, PA (http://www.northcreeknurseries.com);
9. Or approved equal.

B. All nurseries supplying plant material shall have a registration certificate from the Department of Agriculture and Markets, Division of Plant Industry, New York (or similar organization in the state from which plant material is obtained) certifying that the plant material is apparently free of injurious insects, diseases and invasive plant material.

2.02 MATERIALS / EQUIPMENT

A. Trees and Shrubs

1. All woody plant material shall be nursery grown in accordance with good horticultural practice, for at least two (2) years under climatic conditions and soils similar to those at the Site. All plants shall be of specimen quality. All trees are to be uniform and matched. All trees shall have straight trunks with leader intact, undamaged and uncut. Trees with damaged or crooked leaders, bark or abrasions, sunscald, disfiguring knots, or insect damage will not be accepted.
2. All trees shall be freshly dug for this Project. Depth of planting shall be checked on all trees being tagged at the nursery. Remove all soil or other fill material above the natural point where the tree trunk begins to spread, (the flare), prior to digging and ball and burlap operations.
3. Size:
   a. Caliper measurement shall be taken on the trunk at 6 inches above the natural ground line for trees up to and including 4 inches in caliper, and 12 inches above the ground for trees greater than 4 inches in caliper.
   b. Height and spread dimensions refer to the main body of plant, and not from branch tip to tip.
   c. If a range of size is given, no plant shall be less than the minimum size and not less than 50 percent of the plants shall be as large as the maximum size specified.

d. Plants that meet measurements but do not possess a normal balance between height and spread shall be rejected.

e. Plants larger than specified may be used only if approved by Engineer. Use of such plants shall not increase the Contract price. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant. The Contractor shall verify that the size of the root ball will fit in prepared planting pits.

4. All trees shall be either container-grown or balled and burlapped stock (B&B), with a compact natural ball of earth, firmly wrapped and tied in burlap fabric, as appropriate for the size of the plant material.

a. Root ball sizes shall be in accordance with standards specified in ASNI Z60.1

b. Plants with cracked or broken rootballs will not be accepted.

c. Only natural burlap fabric shall be acceptable for balling. Plastic and other non-biodegradable fabrics will not be accepted.

5. Staking and Guying Materials

a. Stakes (where specified only): 3-inch diameter cedar, fir, or hemlock stakes, with pointed ends. Stakes shall be straight, sound, and free from defects that may impair strength. See Contract drawings for stakes minimum sizes.

b. Tree tie: ¾-inch thick polypropylene woven tree tie

B. Drainage Gravel

1. Drainage fill, if required shall conform to the requirements of Section 31 23 23 – Fill, and shall be clean, free from silt and organic materials.

C. Mulch

1. Mulch shall be a double-shredded natural forest product of a uniform grade, partially decomposed, undyed, free from sawdust, with no additives or any other treatment. Size of bark shall be from 5/8 inch to one and 1/4 inch.

2. Mulch sources shall be free of weed seeds, diseases or pest infestations including but not limited to the Emerald Ash Borer, Asian Longhorned Beetle and Spotted Lanternfly. Use of material from any areas that have been designated for quarantine of wood products by any state or federal agency is strictly prohibited.

D. Straw Mulch:

1. Provide air-dry, clean, mildew-and seed-free, salt hay or threshed stray of wheat, rye, oats, or barley.

E. Grass Seed for Lawn Areas

1. Grass seed for lawn areas shall be fresh re-cleaned seed of the latest crop. Use low-maintenance, native, stormwater tolerant, drought resistant grass,

or short groundcover. Unless otherwise specified in the Plans or Contract, seed mixture shall have the following proportions by weight:

2. See Contract Drawings for Seed Mixture All seed shall be delivered in standard size bags of the vendor, showing weight, purity, and percentage of seed varieties.

3. Grass seed for lawn areas shall be provided only for areas where lawn is specified. It shall not be furnished for temporary stabilization prior to final Site restoration in restoration projects.

F. Grass Seed for Hydroseeded Areas

1. Grass seed mix for hydro-seeding shall be fresh re-cleaned seed of the latest crop. Seed mixture shall have the following proportions by weight:

2. See Contract Drawings for Seed Mixture All seed shall be delivered in standard size bags of the vendor, showing weight, purity, and percentage of seed varieties.

3. Grass seed for hydro-seeding shall be provided only for areas where hydro-seeded turf-grass is specified. It shall not be furnished for temporary stabilization prior to final Site restoration in restoration projects.

G. Native Grass and Wildflower Seed Mix

1. Seed for native grass and wildflower seeded areas shall be fresh recleaned seed of the latest crop.

2. Seed shall be as specified on the Contract Drawings. No replacements or substitutions may be made without prior DEP approval.

3. All seed shall be delivered in standard size bags of the vendor, showing weight, purity, and percentage of seed varieties.

H. Filter Fabric

1. Filter fabric shall be non-woven type conforming to the requirements of Section 31 25 10 - Dust, Soil Erosion and Sediment Control.

I. Water

1. The Contractor shall supply all required water to the Site at no additional cost to DEP.

a. The Contractor shall correct all Work injured or damaged because of the lack of water, or the use of too much water, or the use of contaminated water.

b. Water shall be free from impurities injurious to vegetation.

J. Tree Irrigation Bags

1. Unless otherwise shown on the Contract Drawings, required in the Contract, or directed by the Engineer, the Contractor shall furnish tree irrigation bags for all trees over 1-1/2 inch caliper. The irrigation bags shall be 100%

reinforced UV stable polyethylene, at least 10 mils. thick with a polyester scrim lining, such as Tree-Gator, as manufactured by Spectrum Products, Raleigh, NC, or approved equal. The irrigation bags shall have a minimum 20-gallon capacity.

K. Erosion Control Mats

1. Erosion control blankets or mats shall be 100% biodegradable and free of any plastic.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. Approximately one (1) month prior to the expiration of the guarantee period, the Contractor shall arrange a site inspection by the Engineer.
2. At this time, the Engineer will prepare a list of all remedial Work required, including plant replacement and maintenance.
3. This Work shall be carried out before the end of the guarantee period, unless weather conditions cause delays, in which case such Work shall be carried out as soon as is practical, as determined by DEP.
4. The Contractor shall coordinate its Work with that of other Contractors. Such coordination shall include, but not be limited to:
   a. Location of all underground utility lines and structures
   b. Scheduling of planting operations
   c. Scheduling of maintenance operations
5. Drainage at tree pits: If directed by the Engineer, check drainage at tree pits prior to planting, by performing percolation tests (in dry weather) as follows:
   a. Dig out planting hole to required depth and fill hole half full of water. Monitor decrease in water level to determine if drainage is appropriate for soil type. Soils in wetter areas will drain more slowly that soils in dryer areas.
   b. If water does not drain adequately from plant pits, amend conditions at tree pits and planting beds as required for satisfactory drainage. If topsoil or subgrade has been over-compacted by the Contractor's

operations, such as by compaction equipment or by allowing vehicles or equipment to pass over the area, the Contractor shall remove and replace over-compacted materials at its own expense.

c. Obtain approval of Engineer for proposed amendments.

d. Do not place trees in pits until approval of drainage conditions by the Engineer.

6. The Contractor shall be liable for all damage to surrounding areas caused by planting operations and shall be required to restore or replace the damaged areas to their original condition.

7. Contractor is responsible for determining the location of all utilities, by contacting the appropriate utility company prior to any planting activities.

a. Verify that underground utilities and irrigation systems in landscape areas are in place, at the proper location, tested (except final irrigation testing) and ready for use.

1) Take proper precautions so as not to disturb or damage sub-surface elements.

b. Coordinate with other trades.

8. The Contractor is liable for any damage to such utilities during the course of construction, and is responsible for making necessary repairs to damaged utilities at its own expense.

B. Preparation

1. Planting

a. Install filter fabric under planted areas, in areas shown on the Contract Drawings.

1) Fabric shall be overlapped by a minimum of six (6) inches.

2) Fabric shall be held in place with wire staples of adequate quantities to prevent movement of fabric during planting operations.

3) Fabric ends shall be secured in trenches as shown on the Contract Drawings.

4) No fabric shall be visible following completion of planting and seeding operations.

b. Planting soil mix materials and installation shall be as specified in Section 32 90 05 – Soil Mixes.

c. Exercise extreme caution during excavation to avoid damaging or interrupting existing underground utilities. Use appropriate detection equipment to locate utilities during excavation for planting.

d. Erect barricades, warning signs, or other protective devices as may be required by local, state, or federal laws and regulations to protect open excavations.

2. Seeding

a. All areas to be seeded shall be thoroughly loosened to a depth of 6 inches and graded to true lines free from all unsightly variations, bumps, ridges or depressions. All sticks, stones, roots or other objectionable material shall be removed.

b. Provide 12 inches of lawn soil mix, spread evenly over all areas to be seeded. Prepare topsoil to provide a crumbly seedbed, firm and level after tilling.

c. After all materials have been worked in, firm up soil by rolling to eliminate all soft spots. Rake entire area into a crumbly state, with one inch of loose soil at the surface, using a wide-toothed rake or tine-harrow.

d. For additional requirements on the use of soil amendments, refer to Section 32 90 05 – Soil Mixes.

3.02 INSTALLATION

A. For projects within New York City, plant only within the following dates, weather permitting. Do not plant in times of high wind, rain, sleet, or snow when the ground is frozen or excessively wet; or when the soil is otherwise in an unsatisfactory condition for planting. Planting at times other than those specified will be at the Contractor's own risk, and will not invalidate any guarantees.

1. B & B Deciduous trees and shrubs:

a. Spring: March 15 to May 15

b. Fall: October 15 to December 15

2. The following trees shall be planted during the spring season only:

a. Acer rubrum and A. saccharum

b. Betula lenta, B. allegheniensis and B. populifolia

c. Carpinus caroliniana

d. Carya spp.

e. Castanea dentata

f. Cornus alternifolia and C. florida

g. Liriodendron tulipifera

h. Nyssa sylvatica

i. Ostrya virginiana

j. Pinus rigida and P. strobus

k. Quercus spp.,except Q. palustris or Q bicolor
l. Salix amygdaloides
m. Sorbus americana
n. Tilia americana
o. Tsuga canadensis
p. Viburnum lentago and V. prunifolium
q. Betula sp.
r. Crataegus sp.
s. Liquidambar styraciflua
t. Liriodendron tulipifera
u. Platanus acerifolia
v. Prunus sp.
w. Quercus sp.
x. Salix babylonica
y. Tilia tomentosa
z. Zelkova sp.

3. B & B Evergreen trees and shrubs
   a. Spring: March 15 to May 15
   b. Fall: September 1 to December 1
4. Container-grown perennials, vines, and ground cover plants:
   a. Spring: March 15 to July 1
   b. Fall: September 1 to November 1
5. Seeding, and hydroseeding shall be carried out during the following dates:
   a. Spring: April 1 to June 1
6. Fall: September 1 to October 15 Coordinate seeding periods with maintenance periods to provide required maintenance from date of Substantial Completion. Maintenance begins at the time of planting/seeding and continues until the end of the warranty period.
7. Seeding shall be in moderately dry to moist soil, at such times when wind does not exceed five (5) miles per hour. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

B. Do not plant until plant material has been approved by the Resident Engineer at the Site.

C. If planting is delayed more than 6 hours after delivery, provide adequate means of protection from freezing and from the drying effects of wind and sun.

1. Protect root balls with soil, wet mulch, or other acceptable material.
2. Provide shade structures or other covering as required to protect from sunscald.
3. Water as necessary until planted. Do not allow plant material to wilt or show signs of stress from lack of water. Provide all water and equipment for water distribution at no additional cost to DEP.
4. Do not remove container-grown stock from containers prior to planting.

D. Placement of Plants

1. Plants shall be set in the center of pits, plumb and straight, in accordance with the planting details, and faced to give best appearance and relationship to adjacent plants and structures.
2. Plant to such depth that the finished grade level of plant, after settlement, will be the same as that at which the plant was grown.
3. Trees must be planted at the depth of the flare, where roots spread from the trunk. The flare must be located and placed at the correct level before continuing planting operations.

E. Planting Balled and Burlapped Trees and Shrubs

1. Excavate plant pits to minimum dimensions shown on the Contract Drawings. If plant pits are mechanically dug, the sides of the pit shall be broken down or roughened with a shovel or other hand tool to eliminate surface glazing.
2. Remove any platforms, wire, and surplus binding from top and sides of ball.
3. Position plants in center of pit, using gentle handling to avoid damage to any part of the plant.
4. Set plants on a bed of compacted soil mix, to position at the correct depth, as shown on the Contract Drawings.
5. Cut and remove burlap, rope ties, and wire baskets from the root ball, backfilling and gently removing burlap and wire basket in sections as needed to support the root ball.
6. If wire baskets are used to contain the root ball, these shall be entirely removed before planting.
7. Fully remove all burlap, non-biodegradable twine and other materials.
8. Cleanly cut off all visible broken or frayed roots.
9. Add mycorrhizal fungi inoculant, if specified, to each tree planting as per the approved manufacturer’s or supplier’s instructions.

10. Apply water retention additive as per approved manufacturer's or supplier's instructions.

11. Backfilling: Fill plant pit with soil mix by hand, in layers not more than six (6) inches deep, and with each layer thoroughly settled by hand tamping and with water, and free of all voids before next layer is put in place.

12. Install tree irrigation bags and fill with water, unless otherwise specified or directed by the Engineer.

F. Planting Perennials, Vines, and Container Grown Shrubs

1. Excavate plant holes to depth of container and twice the container diameter.

2. Carefully remove plant from container using gentle handling to avoid damage to any part of plant.

3. If roots are loose, spread roots out evenly over a mound of soil mix. If roots are tight and compact, loosen by pulling gently apart. If plant roots will not separate, use a sharp tool to make vertical slits in the root ball, approximately 1/2-inch deep at three or four locations around root mass.

4. Set plants on a bed of compacted soil mix, so that the root ball is level with the surface of the soil.

5. Backfilling: Fill plant pit with soil mix by hand, pushing the mix around and just over the surface of the root ball. Add soil mix in layers not more than four inches (4") deep, and with each layer thoroughly settled by hand tamping and with water, and free of all voids before next layer is put in place.

G. Saucering

1. After backfilling is completed, a saucer shall be made for the retention of water around each plant, unless impracticable because of placement of tree gratings or other paving material over planted area.

2. The saucer shall be of the same diameter as that of the hole dug.

3. The soil lip shall be level all around and shall be at least 4 inches high for trees, and 2 inches high for shrubs.

H. Watering – Plantings

1. Immediately after installation of each plant, the soil around it shall be thoroughly saturated with water.

a. Apply water slowly so as to penetrate the entire root system.

b. Watering shall continue throughout the maintenance and guarantee period, as frequently as seasonal conditions require, until Final Acceptance of the Work.

c. Contractor shall be responsible for adequate water both before and after installation of irrigation system.

I. Mulching

1. After planting operations are complete all plant bed areas shall be covered with approved mulch.

   a. Unless otherwise specified on the Contract Drawings, mulch shall be installed at an even depth of three (3) inches over tree pit and shrub areas and two (2) inches over groundcover beds.

   b. Mulch shall be contained within the plant bed areas and shall not be permitted to spread onto paved areas. Mulch shall not cover plants.

   c. Mulch shall not be placed in direct contact with tree trunks. The area of the root flare shall be left free of mulch.

J. Staking

1. Trees shall be staked only if shown on the Contract Drawings, required in the Contract, or directed by the /Engineer.

   a. Trees shall stand plumb after staking.

   b. Do not use tree wrap.

c. Trees requiring tree stakes shall be staked within 24 hours after planting.

K. Pruning

1. Perform pruning following planting only as shown on the Contract Drawings, required in the Contract, or directed by the Engineer and approved by DEP.

   a. Excessive pruning at the time of transplanting shall be avoided.

   b. Pruning shall be performed by a Certified Arborist in accordance with current best practices of the International Society of Arboriculture.

   c. All deadwood and broken or damaged branches shall be removed. Plants exhibiting suckers should be rejected.

   d. Pruning shall be done with clean, sharp tools.

   e. No leaders shall be cut. Each cut shall be made carefully, at the correct location, leaving a smooth surface with no jagged edges or torn bark. The correct anatomical location is just beyond the branch collar.

   f. Large or heavy limbs shall not be removed.

L. Antidesiccant Spraying

1. Use antidesiccant only as approved by Engineer. Approval is required for each condition of use.

M. Seeding Operations

1. Prepare seedbeds in undisturbed areas by lightly tilling or harrowing to a depth of four (4) inches. No fertilizer is to be applied to wildflower or native grass areas. Prior to preparation of undisturbed sites, remove existing grass, vegetation and turf. Contractor shall take particular care so as not to damage existing plant material adjacent to seeding area while preparing seed bed. Dispose of removed vegetation off-site in accordance with all local laws; do not turn over into soil being prepared for native grass and wildflower seeding.
2. Moisten prepared seeding areas before planting if soil is dry. Do not create a muddy soil condition.
3. Apply seed with drop or cyclone spreader to uniformly cover seedbed at the manufacturer's suggested rate. In general, spring and summer seeding will be at a rate of 30 lbs./acre and winter seeding at a rate of 100 lbs./acre, per NYSDEC guidelines.
4. Small wildflower seeds should be mixed with damp sand and hand sown. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over the entire area.
5. Lightly rake seed into soil, and cover entire area with salt hay or straw mulch, to a thickness of one (1) inch. For larger areas, a mechanical power drawn seeder or combination grass planter and land packer or pulverizer may be used. Seed to be planted not deeper than 1/4 inch. Seeding operations shall be kept as close as possible to the contours and not up and down the slopes.
6. Quick growing cover annual crop should be applied at the manufacturer suggested rate.
7. Water all seeded areas immediately upon installation, taking care not to wash out the seeds, and regularly during first four (4) weeks following seeding to maintain adequate moisture for deep root growth.
8. Seeding shall not be done on frozen ground or when the temperature is 32° F or lower. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
9. Seeded areas shall be protected during establishment.
10. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch and roll to a smooth surface.

N. Hydroseeding

1. All areas to be hydroseeded shall be thoroughly loosened to a depth of 6 inches and graded to true lines free from all unsightly variations, bumps, ridges or depressions. All sticks, stones, roots, or other objectionable material shall be removed.

2. Provide six (6) inches of soil mix and spread evenly over all areas to be hydroseeded. Prepare topsoil to provide a crumbly seedbed, firm and level after tilling. For additional requirements on the use of crushed limestone in the soil mix, see Section 32 90 05 – Soil Mixes.

3. Apply hydroseeding solution with a mobile tank with a centrifugal pump, using a seeding nozzle of a design to produce an even distribution of the solution.

4. Clean and remove all hydroseeding solution from areas outside of the limits of hydroseeding, including removal from structures, walls, paving, trees and other plant material.

O. Watering of Seeded and Hydroseeded Areas

1. The Contractor shall provide all labor and arrange for all watering necessary to establish acceptable stands of planting in seeded areas.

a. Begin watering immediately following installation.

b. Watering shall continue throughout the Contract period until Substantial Completion.

c. During the first two (2) weeks after planting, in the absence of adequate rainfall, watering shall be performed up to three (3) times daily or as often as necessary and in sufficient quantities to maintain moist soil to a depth of at least four (4) inches.

d. After the first two weeks, the Contractor shall water the seeded areas to maintain adequate moisture in the upper four (4) inches of soil, necessary for the promotion of deep root growth.

2. Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one (1) complete coverage to the lawn areas in an eight (8) hour period.

3.03 FIELD TESTING / QUALITY CONTROL

A. Protection and Maintenance

1. At least 30 days prior to the date of the written request for Substantial Completion, the Contractor shall submit a written protection and maintenance program and schedule to the Engineer for approval.

2. Protection and Maintenance program shall be revised and resubmitted as required until approved by Engineer.

3. During the guarantee period, the Contractor shall maintain all plant materials as specified herein, and as noted in the approved maintenance schedule, and shall replace, at no additional cost to DEP, any and all plant material that has died or, in the opinion of the Engineer or Engineer’s designated representative, is in unhealthy or unsightly condition.

4. The Contractor is responsible for providing and maintaining adequate protection measures for all planted areas throughout the guarantee period in order to protect plantings from any subsequent construction operations or other types of physical damage.

    a. Protection measures may include, but not be limited to, approved temporary fencing, tree guards, signage and other measures as determined to be necessary during the guarantee period.

    b. Local fence ordinances and guidelines may also apply to the work, requiring the Contractor to submit design drawings or other documents for obtaining the necessary local permits or approvals at no additional cost to DEP.

B. Reseeding

1. Any areas that fail to show growth within three (3) weeks of seeding shall be immediately reseeded at no additional cost to DEP.

2. Reseeding shall be carried out as many times as necessary until a uniform grass cover is established.

3. Scattered bare spots, none of which are larger than one square foot, will be allowed up to a maximum of 3 percent of any seeded or hydroseeded area.

C. Mowing

1. Mowing of all seeded and hydroseeded lawn/ meadow areas shall begin when grasses and other plants are firmly rooted and secure, and shall continue until Substantial Completion.

2. Mow all grass lawn areas to maintain the grass height between 1-1/2 and 2-1/2 inches and meadow areas up to six (6) inches or as directed by DEP Maintenance Supervisor.

3. Wildflower and native grass seeded areas shall be mown no more than two (2) times per year.

    a. First mowing shall be carried out after seed set and shall not be carried out earlier than September 15 nor later than November 15. Mow to a height of not more than 9 inches.

    b. Second mowing shall be carried out four (4) to six (6) weeks after first mowing, unless otherwise directed by DEP. Mow to a height of between 5 and 6 inches

D. Replacements

1. There will be no limit to the number of times replacements are made of individual plants, unless conditions causing the failure can be proved to be beyond the control of the Contractor.

2. The Contractor is responsible for replacing any and all plant material and any associated compacted soils that are damaged by the Contractor’s own

operations or the operations of any of its subcontractors, or due to other damage resulting from a lack of adequate protective measures, at no additional cost to DEP.

3. All replacements shall be in accordance with original specification or, if it is determined that specified plants are inappropriate for as-built conditions, they may be replaced with the approval of Engineer to more appropriate species as identified by a DEP Restoration Specialist, Landscape Architect or other qualified professional.

4. Cost of all replacements shall be included in the Contract price. No additional payment will be made therefor.

5. Replace unacceptable plant material no later than the next succeeding planting season.

6. Guarantee all replaced material for a period of 18 months after the date of replacement, unless otherwise required in the Contract.

7. All areas damaged or soiled by replacement planting operations are to be fully restored to their original condition at no additional cost to DEP.

E. Substantial Completion

1. The Contractor shall submit a written request to the Engineer, for a formal inspection of the planting Work for Substantial Completion.

2. To be accepted at the time of formal inspection of planting Work, all plant material must be alive, healthy, and installed as specified.

a. If plants are dead, dying, or unhealthy, or if landscaping does not serve its visual or soil stabilization functions, or if workmanship is unacceptable to the Engineer or Engineer’s Representative for other reasons, written notice will be given to the Contractor in the form of a punch list that itemizes all remedial Work required for Substantial Completion.

b. This Work may include plant replacement or maintenance which must be carried out prior to issuance of the Certificate of Substantial Completion.

c. The Certificate of Substantial Completion will not be issued until a written maintenance program, as described herein, has been approved by the Engineer.

F. Final Acceptance

1. Following the completion of all remedial work and replacement plantings, the Contractor shall request the Engineer in writing for a formal inspection of the landscape Work for Final Acceptance.

G. All of the materials and labor required for plant protection, maintenance and replacements during the guarantee period shall be included in the Contractor's bid price. No additional payments will be made therefor.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. Maintenance of all plant material shall begin immediately after planting, and continue until the end of the guarantee period, unless otherwise noted.

2. Defective Work shall be corrected as soon as possible after it becomes apparent and when weather season permits. The Engineer shall be the sole judge of the condition of the plants.

   a. Watering, replanting, reseeding, repair of ruts and erosion, repair of protection devices, weeding and continuous control of invasive species, fertilizing and mowing of lawn areas/meadow.

   b. The removal of all dead, dying or unhealthy plant material, including lawns, and replacement of such material with new plants or seeding to meet all specifications of the original plantings.

   c. Protection from insects, disease, and invasive species to maintain optimum health. Infection or infestation may require removal and disposal off-site followed by replacement with plants free of infection at the discretion of the Engineer's designated representative.

   d. The repeating of any or all phases of planting or lawn/meadow work as specified herein, or that may be required to obtain healthy plantings and a uniform, thick, and well developed stand of grass.

3. Specific Maintenance Tasks: Maintenance shall include, but not be limited to the following:

4. Watering: Water lawns and planted areas as required. Do not permit plant material to wilt or to show signs of stress from lack of water. Contractor shall supply and distribute water to all lawns and plantings during the full time of their establishment at the Site and provide all equipment for water distribution at no additional cost to the DEP. Plants and lawns shall be inspected by the Contractor for watering needs at least once each week, and watered as necessary to promote plant growth and vitality.

5. Mowing: As described hereinbefore.

6. Fertilizers: No pesticide, herbicides, or fertilizers shall be used on the Site after establishment period. Any fertilizers, herbicides or pesticides must be approved in advance by DEP.

7. Rodents: Protect against and exterminate rodents, and repair of any damage caused by rodent activities.

8. Weeding: Weed to keep all planted areas weed-free throughout the guarantee period.
9. Mulching: Add mulch material as required to maintain mulch at specified depth.
10. Resetting: Reset plant material that has settled, to proper grade and position.
11. Pruning: Prune trees and shrubs to remove all dead or broken branches, throughout the guarantee period. Prune flowering shrubs as necessary to ensure flowering.
12. Trimming: Cut back dead stalks, flowers and foliage from perennials in fall after the first frost. Trim or dead-head spent flower blossoms throughout the guarantee period.
13. Anchoring: Maintain any approved tree stakes, ties and other tree anchoring systems, including tightening, repair or replacement as required, and removal at the end of the guarantee period, or as directed by the Engineer.
14. Irrigation: If applicable, coordinate with irrigation system installer for all adjustments to irrigation as required.
15. Instruct the DEP’s maintenance personnel in all maintenance procedures.
16. Maintenance Program
    a. Prior to Substantial Completion, the Contractor shall arrange a meeting with the Engineer and with the DEP's designated maintenance personnel to review together the submitted maintenance program and any modifications required for the duration of the guarantee period.
    b. The Contractor shall make periodic inspections, at no extra cost, during the guarantee period to determine what changes, if any, should be made in the maintenance program.
    c. Any recommended changes shall be submitted in writing to the Engineer.
    d. Additional remedial work not included in the maintenance program shall be carried out by the Contractor as deficiencies are identified and reported by the Engineer or designated maintenance personnel.
17. Replacements
    a. In accordance with the requirements for Warranty (Guarantee Period) under this Section, the Contractor shall replace, as soon as weather conditions permit, and within a specified planting period, all plants determined dead and/or dying by the Engineer or the DEP's designated personnel during and at the end of the guarantee period. Replacements shall be made at no additional cost to DEP.

Labor and all materials needed for installation of replacements shall be included in the warranty.

b. Plants shall be free of dead or dying branches and shall bear foliage of normal density, size, and color.

c. Trees having lost their central leader or exhibit crown dieback at the end of the guarantee shall be replaced.

d. Replacements shall match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this Section.

B. Plant Protection

1. The Contractor shall provide at its own expense all protection that is deemed necessary for all plants and lawn areas against damage prior to Final Acceptance.

2. Removal of Temporary Protection Measures: All temporary protection measures employed during the construction period shall be removed prior to Substantial Completion unless otherwise directed by the Engineer. All stakes and ties used for temporary bracing of trees shall be removed and disposed of by the Contractor off site at its own expense at the end of the guarantee period, or earlier at the direction of the Engineer.

C. Clean Up

1. At the end of each work day the Contractor shall broom-clean the site, to remove all trash, debris, and loose soil materials. Store materials and equipment where directed.

2. Immediately following the completion of planting operations, the Contractor shall remove all excess materials, stockpiles, waste materials, tools, and equipment, and leave the Site in a clear and clean condition.

3. Immediately remove all rejected materials from the Site. All rejected materials and other waste or debris shall become the property of the Contractor, who shall legally dispose of same off-Site.

4. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn/meadow is established.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 32 90 05 - SOIL MIXES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The work of this Section includes but is not limited to the following:

1. Supply of component materials and soil amendments for soil mixes or supply of blended soil mixes from approved off-Site sources.

2. Reuse of existing topsoil stripped from Site.

3. Preparation of soil mixes on Site.

4. Installation, placement, spreading, and fine grading of soil mixes.

5. Testing of all soil component materials, soil amendments, and soil mixes.

B. The Contractor shall implement practices and procedures to meet the Project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	11
2.04	Source Quality Control / Shop Tests	11
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Implementation	13
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 31 23 16 -- Excavation

B. Section 31 23 23 -- Fill

C. Section 31 25 10 -- Dust, Soil Erosion and Sediment Control

D. Section 32 90 00 -- Planting

1.04 REFERENCES

A. ASTM International (ASTM) Standards

1. ASTM D1556 -- Standard Test Method for Density and Unit Weight of Soil in Place by Sand Cone Method

2. ASTM D1557 -- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

3. ASTM D3385 -- Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometers

4. ASTM D4318 -- Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils

5. ASTM D6938 -- Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

6. ASTM F1647 -- Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes

B. The Northeast Coordinating Committee for Soil Testing

1. NEC-1012 -- Recommended soil testing procedures for the Northeast United States, Northeastern Regional Publication Number 493

C. The New York City Department of Health and Mental Hygiene

1. Local Law 37 Pesticide Use by City Agencies – Pesticide Product Search Local Law 37 - NYC Health

D. The New York State Department of Environmental Conservation Bureau of Pesticide Management

1. Pesticide Product Information Portal

2. https://www.dec.ny.gov/nyspad/products?0

E. New York State Department of Environmental Conservation (NYSDEC)

1. 6NYCRR Subpart 360-5, Composting Facilities
2. 6NYCRR Subpart 375-6, Remedial Program Soil Cleanup Objectives
3. 6NYCRR Part 360 Part 360, Solid Waste Management Facilities

1.05 DESCRIPTION

A. System Design Requirements

1. All soil mix components shall be tested and approved prior to incorporation into blended soil mixes.
2. Provide adequate quantities of all soil mix materials to attain, after compaction and natural settlement, all design-finished grades.
3. Sustainable Design Requirements
   a. Regional Materials: Soil shall be extracted within 250 miles of the project site.

1.06 QUALITY ASSURANCE

A. Contractor shall submit written test reports as required in this Section.

1. Testing shall be carried out by an independent testing laboratory.
2. Engineer's approval of the testing laboratory shall be obtained by the Contractor before it is given any work of this Section.
3. Contractor shall be responsible for timely submittal of samples to the testing laboratory.

B. Each test shall be carried out using the categories and sieve sizes as specified herein. Failure to include any of the required criteria will be sufficient cause for rejection of the test.

C. Each test report shall include the following information:

1. Current Project title and Project number.
2. Name of Contractor
3. Name of material supplier or location where material is extracted from
4. Testing laboratory name, address and telephone number
5. Type of test
6. Date of test (No older than 2 months prior to submitting to Landscape Architect/Engineer). All soil mixes/product tests older than two (2) months will be rejected.
7. Test results, **including** identification of deviations from acceptable ranges.

D. Each sample shall be tested, as applicable, for the following:

1. Mechanical analysis: Sieve method, using sieve sizes specified.

2. pH should be measured according to Recommended Soil Testing Procedures for the Northeastern United States (NEC-1012). Where soil will be used to support plant growth, lab analysis results must include corrective recommendations.

3. Organic matter content: Percentage of oven-dry weight of soil, determined by loss on ignition of moisture-free sample, in accordance with Method A of ASTM F1647.

4. Electrical conductivity (soluble salts): Test by saturated paste method in deciSiemens per meter (dS/m).

5. Soil Fertility Analysis: Analysis for available macronutrients including, at a minimum, phosphorus and potassium in parts per million according to methods as specified in NEC-1012. Test methods and fertility recommendations must be included with results.

6. Chemical Analyses shall include the 6 NYCRR Part 375-6 compounds detailed in Section 02 24 20 - Soil Sampling and Analysis. All analyses shall be performed by a testing laboratory certified by the New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH-ELAP). The frequency of testing per volume of fill shall be in accordance with 6 NYCRR Part 360.13 (e)(1), Table 1, Minimum Analysis Frequency for Fill Material.

E. The /Engineer may take and analyze at any time, such additional samples of materials as deemed necessary for verification of conformance to specification requirements. The Contractor shall furnish samples for this purpose upon request and shall perform testing as requested at no additional cost to DEP.

F. No component bulk material for soil mix shall be used or blended into a mix, until test reports have been received and approved by the Engineer. As necessary, make any and all soil mix amendments and resubmit test reports indicating amendments, until approved.

G. Comply with all rules, regulations, laws and ordinances of local, state and federal authorities having jurisdiction. Provide labor, materials, equipment and services necessary for work to comply with such requirements at no additional cost to DEP.

H. Procure and pay for all permits and licenses required for the Work of this Section.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Manufacturer’s technical information, including application instructions where relevant, for all soil amendment materials required.

a. Fertilizers

b. Soil Inoculants

c. Herbicides

d. Water-absorbent Polymer

2. Samples of Soil Mix Components (1-pound package each):
   a. Topsoil -- offsite imported material
   b. Topsoil -- stripped from site
   c. Compost
3. Samples of Blended Soil Mixes (1-pound package each):
   a. Planting Mix
   b. Lawn Mix
4. Test Results for Soil Mix Components (written report for each bulk component):
   a. Topsoil -- offsite imported material
   b. Topsoil -- stripped from site
   c. Sand
   d. Compost
5. Test Results for Blended Soil Mixes (written report for each blended soil mix):
   a. Planting Mix
   b. Lawn Mix
   c.
6. Sources and Manufacturers List: Submit a full list of sources and manufacturers of soil mixes, including component materials and soil amendments.

B. Sustainable Design Submittals:
1. Regional Materials: Provide the following information:
   a. Names of product and manufacturer
   b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).
   c. Indicate the location and distance from the Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. (For assemblies, include the percentage by weight that is considered regional.)

1.08 DELIVERY, STORAGE, AND HANDLING

A. Conform to all governmental regulations in regard to the transportation of materials to, from, and at the job Site, and secure in advance such permits as may be necessary.

B. Packaged Materials: Deliver packaged materials to the location where planting soil mixes are to be blended, in unopened bags or containers, each bearing the name and trademark of the producer, material composition, manufacturers' certified analysis, and the weight of the material.

1. All bags shall be protected from water and contamination with other materials.

2. Retain packages for inspection by Engineer.

3. All packaged materials shall be stored, handled and applied in strict accordance with manufacturer’s instructions.

C. Stockpiles

1. Each stockpile of bulk materials and soil mixes shall not exceed 50 cubic yards, and shall be no more than 6 feet in height, to prevent anaerobic conditions within the piles.

2. All stockpiled materials shall be adequately handled as required in Section 31 25 10 – Dust, Soil Erosion and Sediment Control.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fertilizer shall be as manufactured by:

1. Osmocote®, The Scotts Company, Marysville, OH;

2. Meister®, The Scotts Company, Marysville, OH;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Topsoil - Offsite Imported Material

1. Imported topsoil or soil blends may not be mined from soils defined by the Natural Resources Conservation Service as prime farmland, unique farmland, or farmland of statewide importance. Imported topsoil shall be:

a. Of uniform quality, free from hard clods, stiff clay, hardpan, sods, roots, chips, sticks, partially disintegrated stone, cement, ashes, slag, concrete, tar residues, tarred paper, boards, or any other undesirable

material. No topsoil shall be delivered in a frozen or muddy condition.

b. Free from refuse, material toxic or otherwise deleterious to plant growth, seeds, or other viable propagules of invasive plants. Construction and demolition debris as classified under 6 NYCRR Part 360, other than uncontaminated land clearing debris, shall not be used to amend topsoil.

c. Free of stones over 1 ½ inches in diameter, and will have less than 10 percent gravel.

2. Topsoil shall conform to the following requirements:

a. pH 5.5 to 6.5

b. Organic content 4 - 6%

3. Topsoil shall conform to the following mechanical analysis:

Sieve Size	Percent Passing
1"	100
1/4"	90 - 99
# 10	80 - 100
# 40	40 - 60
# 60	40 - 60
# 100	10 - 30
# 200	10 - 20

4. When the topsoil otherwise complies with the requirements of the specification but shows a deficiency of not more than one percent (1%) organic matter content; then humus, compost, or other approved organic matter may be incorporated when or as permitted by the Engineer.

5. Topsoil shall not contain hazardous waste, petroleum spills or other chemical releases, or industrial waste. Any shipment of topsoil that does not meet this requirement will be rejected by the Engineer and shall not be brought on Site.

6. Topsoil being brought on site shall be sampled and must meet the definition of General Fill as defined in NYSDEC 6 NYCRR Part 360.13 (f), Table 2: Fill Material Beneficial Use, unless otherwise approved by the Engineer. Topsoil to be used in ecologically sensitive sites (e.g., wetlands) shall meet the SCOs for the protection of Ecological Resources, unless otherwise approved. See Section 31 23 23 – Fill.

B. Topsoil - Stripped from Site

1. Reuse of topsoil stripped from site shall be used for this work when feasible, provided it meets:
    a. All the requirements of physical properties for imported topsoil as specified hereinbefore; and
    b. The requirements for beneficial use of excavated soil as specified under 6NYCRR § 360-1.15(b). See Section 31 23 23 - Fill.

C. Compost
1. Shall conform to the following requirements:
    a. Material shall be capable of sustaining the growth of vegetation, with no admixture of refuse or material toxic to plant growth.
    b. Material shall be derived from organic wastes such as food and agriculture residues, composted cow or other animal manures, sewage sludge or other materials that meet the specified requirements.
    c. Material shall be screened, and shall be free of any stones, branches, roots, brush, weeds, or wood chips, and all debris such as plastic fragments, glass, and metal fragments.
    d. Organic content: 50% minimum.
    e. pH: 5.5 to 7.0.
    f. Carbon/nitrogen ratio: 25:1 to 35:1.
    g. 100% passing 1/2" screen .
2. Compost shall meet the requirements for “Monthly Average Concentration” pollutant limits, except where the Engineer specifically allows the use of the “Maximum Concentration” pollutant limits, as stated in the current version of 6 NYCRR Part 360.
3. No compost shall be delivered until the approval of samples by the Engineer, but such approval does not constitute final acceptance. The Engineer reserves the right to reject, on or after delivery, any material which does not, in their opinion, meet these specifications. When compost is stored on the job, it shall be done as directed by the Engineer.
4. Certification: Only facilities permitted to compost biosolids under 6 NYCRR Part 360, will be allowed to furnish finished compost for use in topsoil. The certification shall be supplied by the Contractor prior to the delivery of any composted biosolids, topsoil containing sewage sludge, or other such regulated material to the Site.

D. Soil Amendment Materials: Within the watershed, fertilizers shall not be used unless a soil test indicating a need for soil amendment is provided. Recommended materials below may not be used except where they fulfill amendment requirements. Where authorized for use in the Contract Documents, or by written

direction of the Engineer, Soil Amendment Materials shall have the following compositions:

1. Soil Fertility Analysis: Available macronutrients including Phosphorus and Potassium should be adequate to support the intended plant community. Available macronutrients shall not be at excessive levels that could potentially impair plant growth or impact water quality. The determination as to whether available nutrients are low, optimum, or excessive shall be made and reported by the soil testing laboratory based on extraction and test methods used.

    a. Only when soil analysis indicates a need and if approved in advance by the Engineer, apply commercial fertilizer and uniformly work in to top one inch of seedbed. The rate of application shall be determined by soil analysis.

    b. Do not apply superphosphate except where specifically indicated and as approved by the Engineer. Where required, uniformly work in to top one inch of seedbed. The rate of application shall be determined by soil analysis.

2. In addition to obtaining the Engineer's approval of the type(s) and N-P-K (Nitrogen-Phosphorus-Potassium) analyses of soil amendment materials, proposed based on soil test results, the Contractor shall meet the following requirements:

    a. Bonemeal: Shall be finely ground.

    b. Commercial Fertilizer: A minimum of 50% of the nitrogen shall be derived from organic sources.

    c. Controlled-release Fertilizer: Shall be in granular form.

3. Limestone: Shall be granular limestone, produced from Dolomitic limestone specifically for use in planting, with a minimum of 88% of calcium and magnesium carbonates, conforming to the following requirements:

Sieve Size	Percent Passing
# 10	100
# 20	90 minimum
# 100	60 minimum

4. Only when chemical analysis indicates a need and where approved by the Engineer, apply ground limestone and uniformly work in to top one inch of seedbed. The rate of limestone application shall be dependent on the pH of the soil, as determined by chemical analysis, and shall be as follows:

pH of Soil	Rate: Pounds/1000 Square Feet
5.0 to 5.5	100
5.5 to 6.0	50
6.0 to 6.8	25
over 6.8	0

5. Sulfur: Lower pH if required, by use of elemental sulfur product.
   a. Peat moss or copper sulfate may not be used to lower pH.
6. Mycorrhizal Fungi Inoculant
   a. For tree plantings, the Contractor shall supply Mycorrhizal Fungi Inoculant, if specified, in granular form such as by means of a three ounce (3 oz.) premeasured dry formulation packet, such as Mycor Tree Saver Transplant®, as manufactured by Plant Health Care, Inc., Pittsburgh, PA, or approved equal.
7. Water Retention Additive
   a. Water Retention Additives for tree plantings shall be a granular polyacrylamide polymer of a potassium base and not a sodium base that slowly releases moisture into the root zone such as Terra Sorb, as manufactured by Plant Health Care, Inc., 440 William Pitt Way, Pittsburgh, Pa., or approved equal.

E. Herbicides and Pesticides shall be in compliance with NYC Local Law 37 of 2005 and in conformance with the guidelines of NYC Department of Health for determining whether a pesticide or herbicide is prohibited by the Law.

F. Planting Soil Mix
1. Planting Mix shall conform to the following requirements:
   a. Organic Matter: 4.5 % minimum
   b. pH: 5.5 to 6.5
   c. Electrical Conductivity (soluble salts): 0.7 to 1.5 dS/m
2. Mix shall consist of the following proportions by volume:
   a. Six parts topsoil
   b. Two parts compost
3. The following items shall be added to the above mix if specified in contract drawings or approved in writing by the Engineer:
   a. Five pounds bonemeal per cubic yard of soil mixture
   b. One pound commercial fertilizer per cubic yard of soil mixture

c. One pound controlled release fertilizer per cubic yard of soil mixture

d. Two pounds water absorbent polymer per cubic yard of soil mixture, or as recommended by manufacturer

e. Ground limestone as required for specified pH

G. Lawn Mix

1. Lawn Mix for all seeded and hydroseeded areas, shall conform to the following requirements:

a. Organic Matter: 4.5 % minimum

b. pH: 5.5 to 7.0

c. Electrical Conductivity (soluble salts): 0.7 to 1.5 dS/m

2. Mix shall consist of the following proportions by volume:

a. Six parts topsoil

b. Two parts compost

c. Two parts sand

d. One part perlite

3. The following items shall be added to the above mix if specified in contract drawings or approved in writing by the Engineer:

a. Five pounds bonemeal per cubic yard of soil mixture.

b. One pound commercial fertilizer per cubic yard of soil mixture.

c. One pound controlled release fertilizer per cubic yard of soil mixture.

d. Two pounds water absorbent polymer per cubic yard of soil mixture, or as recommended by manufacturer.

e. Ground limestone as required for specified pH

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination

1. Prior to soil mix placement, the Contractor shall examine the site to determine the status of construction and existing condition in and near the areas to be planted.

2. The Contractor shall ascertain the location of all existing and proposed electric cables, conduits, irrigation, under-drainage systems and all other underground or at grade utilities, by contacting the appropriate utility company. The Contractor shall comply with the requirements of Section 31 23 16 - Excavation prior to any excavation work.

    a. Contractor shall take proper precautions so as not to disturb or damage any sub-surface elements.

    b. Contractor shall be liable for and all damage to such utilities during the course of construction, and shall be responsible for making requisite repairs to damaged utilities at Contractor's own expense.

    c. Contractor shall be liable for any and all damage to surrounding areas caused by planting operations and shall be required to restore or replace damaged areas to original conditions, to the satisfaction of the Engineer.

3. The Contractor shall comply with the requirements of Section 31 25 10 - Dust, Soil Erosion and Sediment Control.

4. The Contractor shall coordinate, adjust, and relate together, work of this Section with other work of the Project and with work of other Contractors. Such coordination shall include but not be limited to the following:

    a. Scheduling of planting operations

    b. Scheduling of maintenance operations

5. The Contractor shall also:

    a. Verify that all work requiring access through or adjacent to areas where soil mixes are to be placed has been completed and no further access (other than landscape installation) will be required. In the event that access will be required, this must be coordinated with the Engineer.

    b. Perform soil mix blending and site soil work only during suitable weather conditions. Do not handle, haul, place, work, disc or rototill soil when frozen, excessively wet, or in otherwise unsatisfactory condition.

B. Preparation of Soil Mixes

1. Excavation of subgrade shall conform to the applicable requirements of Section 31 23 16 - Excavation.

2. Uniformly blend all ingredients as required for each soil mix type, by wind rowing and/or tilling on a hard surfaced area.

a. The components of all soil mixes shall be blended so that ingredients are thoroughly incorporated into the mixture to assure uniform distribution.

b. Do not over-mix, mix shall remain friable and well aerated.

c. Organic matter shall be maintained moist, not wet, during blending.

d. Delay mixing of any approved fertilizers if planting will not follow within a few days.

e. Add mycorrhizal fungi inoculant, if specified, to each tree planting at rate specified by approved manufacturer.

f. Apply water retention additive as per approved manufacturer's instructions.

C. Preparation of Sub-Grade

1. Verify as-constructed or existing sub-grade elevation and perform additional grading operations as necessary to bring the sub-grade to a true, smooth, slope parallel to the finished grade, at all areas to receive soil mixes.

2. Any sub-grades or soils polluted by gasoline, oil, plaster, construction debris, unacceptable soils, or other substances which would render material unsuitable for plant growth, shall be removed from the premises, at no additional cost to DEP, whether or not such pollution occurred or existed prior to or during the Contract period. In the event that such material is placed, this material shall be removed and replaced with approved material. All remedial operations associated with soil mixes shall be reviewed and approved by the Engineer.

3. Clean sub-grade and dispose of all debris prior to placement of soil mixes.

a. Remove all large clods, lumps, brush, roots, stumps, litter, trash, and other foreign material and stones one-half inch in diameter or larger.

b. Dispose of removed material legally off-site in accordance with the applicable laws and regulations and the requirements for waste disposal under the Contract.

4. Where specified in contract drawings or approved in writing by the Engineer, spray all vegetation on sub-grade with a pre-emergent weed killer at the rate of application recommended by the manufacturer.

5. Protect adjacent pavements, walls, utilities and other construction from damage or staining by any soil mix placement operations.

3.02 IMPLEMENTATION

A. Placement of Soil Mixes

1. Do not place any muddy or wet Soil Mixes.

2. Place and spread soil mix over sub-grade, to a depth sufficiently greater than the depth required for planting areas so that after settlement the completed

work will conform to the lines, grades, and elevations shown or otherwise indicated.

3. Place and spread soil mix over the approved sub-grade, in 6-inch lifts, or as directed by Engineer, and settle to eliminate air pockets and minimize settlement. Lightly scarify previously placed surfaces prior to placing subsequent lifts.

4. Compact to 90% Modified Proctor, unless otherwise specified in the Contract Documents.

   a. Provide compaction testing to conform with the specified compaction density.

   b. Fills shall not be so compacted as to restrict the flow of air or water through the soil.

5. After completion of compaction operations, protect the installation from additional compaction from vehicular traffic, contamination by toxic materials or trash, and from water containing cement, clay, silt or any other materials.

6. Any soils that are over-compacted or contaminated after placement or otherwise made unsuitable for plant growth shall be removed from the premises and replaced with approved material or satisfactorily remediated at no additional cost to DEP.

7. The Contractor shall also meet the applicable requirements on placement of soil mixes for different planting operations in Section 32 90 00 – Planting.

B. Grading of Soil Mixes

1. After settlement has occurred, add soil to maintain finished grades. If for any reason soil is left exposed for a long duration prior to planting, add soil and regrade as required.

2. Protect placed soil mixes against construction activity with snow fencing or by other acceptable methods.

3. Protect from the eroding effects of wind and rain with filter fabric, as necessary.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Clean up

1. At the end of each work day the Contractor shall broom-clean the Site, to remove all trash, debris, and loose soil materials.

2. Immediately following the completion of soil mix installation operations, the Contractor shall remove all excess materials, stock piles, waste material, tools and equipment, and leave the site in a clear and clean condition.

3. All waste materials shall be disposed offsite by the Contractor in accordance with the applicable laws and regulations and the requirements for waste disposal under the Contract.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 33 01 10.60 – DISINFECTION OF PIPING, TANKS, STRUCTURES, AND EQUIPMENT

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Before Certification of Substantial Completion can be issues, the Contractor shall provide all labor, materials (including sodium hypochlorite and other chemicals), equipment (including taps, corporation stops, temporary pumps, hoses, and miscellaneous piping), and incidentals necessary to perform complete and comprehensive flushing, disinfection and satisfactorily complete testing of all pipelines, conduits, pumps, tanks, structures, and equipment which are to store, handle, or carry potable water.

B. The Contractor shall remove said materials and equipment after completion of the disinfection procedure. Water for the initial disinfection procedure shall be furnished by DEP.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	3
2.04	Source Quality Control / Shop Tests	3
PART 3	EXECUTION	3
3.01	Examination / Preparation	3
3.02	Implementation	3
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

1. AWWA C651 Disinfecting Water Mains
2. AWWA C652 Disinfection of Water-Storage Facilities
3. NSF/ANSI 60 – Drinking Water Treatment Chemicals – Health Effects
4. NSF/ANSI 61 – Drinking Water System Components – Health Effects
5. New York City Plumbing Code Section 610 - "Disinfection of Potable Water System."
6. New York City Plumbing Code Section 606.5.4.5 - "Installation of the Building Water Distribution System - Cleaning or Painting"
7. New York City Department of Health

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Disinfection shall be in accordance with AWWA C651 for water mains and AWWA C652 for water storage facilities and equipment, except as modified herein. Disinfection procedures for new water mains and water storage facilities shall also conform to the requirements of the New York City Plumbing Code, Section 610 "Disinfection of Potable Water System" and Section 606.5.4.5 "Installation of the Building Water Distribution System - Cleaning or Painting" respectively, except as modified herein.

1.07 SUBMITTALS

A. Not Used

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

SECTION 33 01 10.60 – DISINFECTION OF PIPING, TANKS, STRUCTURES, AND EQUIPMENT

CONTRACT PS-318

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. All chemicals used for disinfection including but not limited to sodium hypochlorite solution or dechlorinating chemicals shall meet NSF/ANSI Standard 60 and listed by NSF or UL for the application.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Pipelines:

1. Pumps, hydrants, and other water handling equipment items that are part of the potable water distribution system shall be disinfected in the same manner as described herein for the pipelines.

2. Pipelines shall first be flushed with clean water to remove any and all materials that may have entered the pipe during construction. Disinfection shall be accomplished by the Continuous Feed Method, as specified in AWWA C651, using sodium hypochlorite solution.

3. Water-chlorine solution with a concentration not less than 50 mg/l of available chlorine shall then be added at one end of the section being disinfected and discharged at the far end. The water-chlorine solution shall be added until the water coming from each downstream blowoff has a residual of not less than 25 mg/l of chlorine.

4. The pipelines shall then be closed, and the solution allowed to remain in the lines for at least 24 hrs. The chlorine residual in the pipeline shall then be rechecked. If the free chlorine residual is less than 10 mg/l after 24 hrs, the procedure shall be repeated until the free chlorine residual after 24 hrs is 10 mg/l or greater.

5. After the 24-hr holding period, the pipelines and equipment shall be thoroughly flushed and filled with clean water. Flushing water shall not be permitted to enter existing water mains.

6. Flushing water shall not be discharged to sanitary or storm sewers without permission of the NYCDEP. Where necessary, Federal, State and local regulatory agencies shall be contacted to determine special provisions for the disposal of heavily chlorinated water.

7. When new potable water pipelines are to be connected to an existing water distribution system, the connecting piping shall be disinfected and tested in accordance with the procedure set forth in Section 9.1 or Section 9.2, as applicable, of AWWA C651.

B. Water Supply:

1. Water for the first filling, disinfection and flushing procedure of each pipeline, tank and piece of equipment will be furnished by the DEP, at no cost to the Contractor, from the nearest hydrant or other source. The Contractor shall provide all necessary apparatus to convey the water to the point of use and perform the disinfection procedure. If the water in the pipelines or storage facility fails the bacteriological tests, water for subsequent disinfection procedures shall be provided by the Contractor. If agreeable to the DEP, water for the subsequent disinfection procedures may be furnished by the DEP but shall be metered, and the Contractor shall credit the DEP for the cost of water used for the subsequent procedures.

3.03 FIELD TESTING / QUALITY CONTROL

A. After the completion of disinfection, bacteriological samples shall be taken by the Contractor and tested at a certified laboratory. Samples shall be taken as required by the New York City Department of Health. The test reports shall be submitted to the Engineer for review and approval. If the samples are not satisfactory, the entire disinfection and flushing procedure shall be repeated at the expense of the Contractor until satisfactory samples are obtained.

B. Disposal of Flushing Water

1. Water flushed containing chlorine residual from structures, equipment or pipelines after completion of disinfection shall be treated with an approved reducing agent to neutralize the residual chlorine in accordance with the recommendations outlined in AWWA C651, C652 and C653.

2. The Contractor shall dispose of the flushing water in accordance with all federal, state and local regulations. Flushing water shall not be discharged to sanitary or storm sewers without permission of the NYCDEP and the authority having jurisdiction of the sewers or storm water system. The Contractor shall be responsible for obtaining all necessary permits required for discharge to a receiving stream, the storm water system or the sanitary sewer.

3. The Contractor may also opt to have the flushing water removed from the site by a waste hauler at no additional cost to DEP.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 33 05 05.30 – LEAKAGE TESTING FOR BURIED PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to test all buried piping and structures completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Implementation	4
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 33 05 05 – Buried Piping Installation.

B. Section 33 06 01 – Schedule for Buried Piping

1.04 REFERENCES

A. Definitions:

1. Buried Piping: Includes all piping beginning at the outside face of a structure or foundation and extending away from structures. Buried piping includes piping beneath structures or foundations.

2. Exposed Piping: Includes all piping beginning at the outside face of a structure or foundation and extending inside. Exposed piping also includes all piping embedded in concrete, as well as all piping that is permanently or intermittently submerged and/or installed in a subaqueous environment.

B. Reference Standards:

1. ACI 350.1-10 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.

2. AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances.

3. Section 312 of The New York City Plumbing Code.

1.05 DESCRIPTION

A. This scope of this Section includes the requirements for the testing of buried piping, except where testing requirements for buried piping are shown or specified elsewhere in the Contract Documents. In addition:

1. The scope of this Section also includes the requirements for testing buried gravity sewers and concrete structures.

B. All buried pipelines, gravity sewers, and structures for which testing requirements are specified in this Section shall be watertight or airtight, including, but not limited to:

1. All buried piping and appurtenances installed under Section 33 05 05 - Buried Piping Installation.

2. All buried piping, structures, and appurtenances installed under other Sections, but that specify testing under this Section.

C. Piping and structures which fail leakage tests shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Engineer. These repaired piping and structures shall then be retested at the Contractor's expense until leakage test results meet the requirements specified herein.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. Buried piping testing submittals shall be submitted under the specification section number

corresponding to the buried piping material. In addition, submittals shall include, but not be limited to:

1. Action Submittals:
    a. Testing Procedures:
        1) Submit proposed testing procedures, methods, apparatus, and sequencing.
        2) Testing procedures shall be submitted for approval at least 30 consecutive calendar days (ccd) prior to the test.
    b. Testing Report:
        1) Prior to placing the piping system or structure in service, submit for review and approval a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which, the leakage test data is based.
2. Informational Submittals:
    a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
    b. Results of each specified field quality control test.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. The Contractor shall provide all labor, equipment, air, water and materials, including meters, gauges, blower, pumps, compressors, hoses, fuel, water, bulkheads, temporary bracing and restraints, temporary weirs, valves, plugs, and accessory equipment necessary and required to complete the testing as specified herein.

B. Testing medium:

1. The Contractor shall provide all air or gasses necessary or required for testing.

2. Unless otherwise specified, the existing facility shall provide all water (or process fluid) required for testing.

    a. The Contractor shall provide all means to convey the fluid into the piping being tested.

3. Refer to the Contract Drawings for availability of water to be used for testing.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Notification:

1. Provide the Engineer with written notice at least 14 ccd prior to the date of testing.

    a. No tests shall be conducted without an approved written procedure.

    b. The Engineer shall respond in writing to the Contractor within 7 ccd of receiving the written notification.

B. All leakage tests shall be conducted in the presence of the Engineer.

1. All leakage tests shall be conducted in the presence of local authorities having jurisdiction, if required.

C. Remove or protect devices and appurtenances that could be damaged by testing.

D. Backfilling of buried or concealed pipelines:

1. Completely backfill all harnessed sections of buried or concealed piping before such sections are tested.

2. Non-harnessed sections of buried piping shall be tested before backfilling.

3.02 IMPLEMENTATION

A. General:

1. Perform leakage testing for all buried piping in accordance with the requirements of Section 33 06 01 - Schedule for Buried Piping, except piping explicitly shown or specified as exempted from testing. For pipelines not listed in Section 33 06 01 – Schedule for Buried Piping:

    a. Test all buried pipelines using a hydrostatic test.

    b. Test all gravity sewers and drain lines under 36 inches in diameter using a hydrostatic test with compressed air.

c. Test compressed air and gas pipelines using a hydrostatic test with compressed air.

d. Test all other pipelines not listed in Section 33 06 01 – Schedule for Piping, including outfall sewers, via a hydrostatic test with clean water.

e. Test vents and drains in plumbing systems and plumbing soil pipe lines in accordance with Section 312 of the New York City Plumbing Code, unless otherwise specified. Unless specified otherwise, test all vents and drains on process piping as for plumbing systems.

2. Operation of Existing Facilities:

a. Conduct all tests in a manner to minimize interference with operations of existing facilities or other contractors working on the Site.

3. Testing of pipelines and conduit with non-circular cross-sections:

a. Leakage in pipelines of other than circular section shall not exceed an amount based on a circular section having an equivalent inner perimeter.

B. Hydrostatic Testing

1. Application:

a. Buried pipelines.

2. Test Procedure:

a. Maintain the testing medium at the specified pressure for a period of 4 hrs.

1) Unless otherwise specified, the testing medium shall be clean water.

2) Do not use air for hydrostatic testing of pipelines intended for liquid service – use compressed air (or gas) only for the hydrostatic testing of air (or gas) pipelines.

b. Test the piping as a whole or in sections.

1) The Contractor shall use valves or install temporary bulkheads at the ends of each section.

2) Remove temporary bulkheads at the conclusion of the hydrostatic testing.

c. Apply the specified hydrostatic test pressure to the piping through a tap in the pipe by means of a pump, compressor, or other approved method.

3. Test Pressures:

a. Test the pipeline at the pressure specified in Section 33 06 01 - Schedule for Buried Piping.

b. If no test pressure is specified for a hydrostatic test, submit a test pressure of 1.5 times the maximum possible operating pressure of the pipeline, for approval by the Engineer.

4. Leakage:

a. The allowable leakage shall not exceed the testing allowance given by the following formula from AWWA Standard C600:

$$L = \frac{S \cdot D \cdot \sqrt{P}}{148{,}000}$$

Where: L = testing allowance (makeup water) (gph).
S = length of pipe tested (ft).
D = nominal diameter of the pipe, (in.).
P = average test pressure during the hydrostatic test (psig).

5. Repair:

a. Replace broken pipe or joint assemblies found to leak.

b. When leakage occurs in excess of the specified amount, locate and repair defective valves, pipe, cleanouts or joints.

c. If defective portions cannot be located, remove and reconstruct as much of the original work as necessary to obtain piping that meets the leakage requirements specified herein and retest, all at no additional cost to the DEP.

C. Hydrostatic Testing of Valves

1. Test Procedure:

a. Prior to the application of the test pressure, operate the valve(s) through the number of complete cycles of closing and opening recommended by the manufacturer.

b. Next, apply the test pressure to one side of the valve (i.e., the first side).

1) The valve shall be in the closed position.

2) Introduce the liquid testing medium to the first side only and apply the test pressure.

a) The other side of the valve(s) (i.e., the second side) shall be dry and unpressurized (0 psig).

3) Maintain the testing medium at the specified pressure for a period of 4 hrs.

c. Then, reverse the side to which the test pressure is applied.

1) The valve shall still be in the closed position.

2) Now apply the test medium and pressure to the other side of each valve (i.e., the second side).

3) The side tested first (i.e., the first side) shall now be unpressurized (0 psig).

4) Maintain the testing medium at the specified pressure again for a minimum period of 4 hrs.

d. Hydrostatic testing of valve(s) may be concurrent with hydrostatic testing of pipeline section(s) to the extent permissible by the testing requirements specified herein.

e. The Contractor shall be responsible for draining and disposing of the test medium in accordance with the requirements of the Contract Documents, as necessary and required to test both sides of each valve in this manner.

2. Test Pressure:

a. Hydrostatic test each valve such that the differential pressure across the valve at the same test pressure specified for the pipe in which the valve is installed.

3. Leakage:

a. Stop all external and internal leakage through the valves.

b. No leakage across the valve shall be acceptable.

4. Movement:

a. Stop all valve movement or structural distress.

b. No movement of the valve is acceptable.

D. Tests for Concrete Structures

1. Application:

a. Wet wells, tanks, channels, containment areas, and other water retaining structures.

2. Test Procedure:

a. Test according to the requirements of ACI 350.1 and as specified herein.

b. The Contractor shall supply all materials and labor needed to conduct the test as specified herein.

c. Prior to start of leakage testing, the following requirements shall be met:

1) All elements of the structure which resist any portion of the retained liquid pressure shall be in place and at specified strength levels. All concrete shall be fully cured.

2) Structure walls shall not be backfilled prior to leakage testing.

3) All valves, gates, blind flanges, and other non-concrete items which control the flow or otherwise retain the liquid contents of the structure, shall be checked for water-tightness. If not water-tight, means shall be taken to assure water-tightness during the period of the leakage test.

4) The portions of the structure to be tested shall be cleaned of all construction debris, standing water, soil, foreign materials and any other material which interferes with the exposed concrete surfaces of the structure.

5) Defective concrete shall be repaired.

6) The Contractor shall notify the Engineer a minimum of 24 hrs prior to start of filling of structure for leakage testing.

7) Leakage testing shall not start until the structure is inspected by the Engineer.

d. Filling the Structure with Water:

1) The portion of the structure to be tested shall be filled at a rate not to exceed 2 ft/hr.

2) The structure shall be filled to the normal operating depth of the structure as indicated on the Contract Drawings.

a) Where no operating depth is indicated or where operating depth is controlled by flowing over a weir, the structure shall be filled to a depth 6 in. below the weir or top of wall elevation, whichever is lower.

3) Water in the structure shall be maintained at the specified test elevation for a minimum of 3 days prior to the start of the leakage test.

e. After water has been brought to the test elevation, the exposed elements of the structure shall be inspected for leakage.

1) All locations which exhibit any amount of leakage flow shall be repaired prior to the start of leakage testing.

f. Unless otherwise specified, the leakage test duration shall be based on ACI 350.1 or last 3 days, whichever is greater.

g. Measure for leakage at the test locations:

1) Structure cells which are less than 1000 ft^2 in area: measurements of water shall be taken at two (2) locations which are located approximately 180° apart.

2) Structure cells which are greater than 1000 ft^2 in area: measurements of water level shall be taken at four (4) locations which are located approximately 90° apart.

3) Each test location shall be marked and given a reference number.

a) A reference point shall be marked on the face of the wall above the test water surface in a manner which will prevent its movement or deterioration during the period of the test.

4) Test locations must be approved by the Engineer.

h. Account for evaporation and precipitation while measuring for leakage:

1) In open structures, a clear plastic calibrated open-top container not less than 18 in. in diameter and depth shall be partially filled, floated in the tank, and held in position near each measurement location.

2) The container shall be located so as not to be shaded by tank walls and away from any items passing over it such as beams or pipes.

i. Leakage tests shall not be started when periods of severe weather conditions or major changes in average daily temperature are predicted.

j. The following measurements shall be recorded at each test location at the start of the test period and at 24-hr intervals thereafter:

1) Distance from reference point to test water surface.

2) Depth of water in the floating container.

3) Temperature of the test water at 18 inches below water surface.

4) Temperature of the water in the evaporation-precipitation container at mid-depth.

3. Leakage:

a. The change in water surface elevation at each test location shall be averaged.

b. The total change in test water surface elevation shall then be adjusted by the average change in water surface elevation in the evaporation-precipitation containers.

c. Where averaged water temperature measurements vary by more than 3°F from start to completion of the test period, adjustment in tank volume shall be determined by change of water density resulting from the change in the average water temperature.

d. Leakage Allowance

1) For unlined concrete structures: the maximum allowable leakage rate shall be 0.075% of the volume per 24-hr period.

2) For concrete structures with walls lined by a waterproof material, the maximum allowable leakage rate shall be 0.050% of the volume per 24-hr period.

4. Retesting and Repair:

a. The leakage test shall be considered as failed if the specified leakage allowance is exceeded or if any leakage is observed.

b. If the test becomes unreliable due to excessive precipitation or other external factors, it shall be restarted.

c. If a leakage test fails, it may be retested immediately without repairs if approved by the Engineer.

d. If subsequent leakage tests fail, the Contractor shall repair all probable areas of leakage and the leakage test shall be repeated.

1) The structure shall be retested until it meets the specified leakage criteria.

2) Repairs shall be made to the probable leakage areas before each retest.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 33 05 05 – BURIED PIPING INSTALLATION
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to install all buried piping complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	8
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	20
3.05	Adjusting / Protection / Cleanup	20

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 31 23 16 – Excavation.

B. Section 31 23 19 – Dewatering.

C. Section 31 23 23 – Fill.

D. Section 33 05 05.30 – Leakage Testing for Buried Piping.

E. Section 33 06 01 – Schedule for Buried Piping.

F. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

G. Section 40 05 07 – Hangers and Supports for Process Piping.

1.04 REFERENCES

A. Definitions:

1.	Buried Piping:	Includes all piping beginning at the outside face of a structures or foundation and extending away from structures. Buried piping includes piping beneath structures or foundations.
2.	Exposed Piping:	Includes all piping beginning at the outside face of a structures or foundation and extending inside. Exposed piping includes interior piping. Exposed piping also includes all piping embedded in concrete, as well as all piping that is permanently or intermittently submerged and/or installed in a subaqueous environment.

B. Reference Standards:

1.	ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
2.	ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
3.	ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
4.	ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
5.	ASTM D2564	Standard Specification for Solvent Cements for PVC Plastic Piping Systems.
6.	ASTM D2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining PVC or CPVC Pipe and Piping Components with Tapered Sockets.
7.	ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

8.	ASTM F656	Standard Specification for Primers for Use in Solvent Cement Joints of PVC Plastic Pipe and Fittings.
9.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
10.	AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances.
11.	AWWA C606	Standard for Grooved and Shouldered Joints.
12.		
13.	AWWA M23	PVC Pipe – Design and Installation.
14.	AWWA M41	Ductile-Iron Pipe and Fittings.
15.	DIPRA	Installation Guide for Ductile Iron Pipe.
16.	NSF61	Drinking Water System Components Health Effects.

1.05 DESCRIPTION

A. This scope of this Section includes the requirements for the installation of buried piping, except where installation requirements for buried piping are shown or specified elsewhere in the Contract Documents. In addition:

1. The scope of this Section includes requirements for:
    a. The jointing of buried piping
    b. The installation of gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, and tie rods.
    c. Modifications and/or adjustments to existing buried piping.
    d. The installation of supports, restraints, and thrust blocks.
    e. The cleaning, disinfecting, and field testing of all buried piping.
2. The extent of buried process piping is shown on the Contract Drawings. The Contractor shall provide additional buried pipe as necessary and/or required to complete the Work as shown and specified. Buried pipe service, pipe diameter, coating, lining, pressure rating, joint type, and testing requirements are specified in the following section(s):
    a. Section 33 06 01 - Schedule for Buried Piping.
3. Where shown on the Contract Drawings, the Contractor shall provide all labor and materials for making connections between buried piping and existing lines(s) installed under other contracts, including all specials required to connect buried pipe to pipe of dissimilar material(s).

1.06 QUALITY ASSURANCE

A. Wherever the installation requirements of this Section and the referenced standards or manufacturer requirements are in conflict, the more stringent provision shall apply.

B. Ductile Iron Pipe:

1. Refer to the latest edition of the DIPRA Installation Guide for Ductile Iron Pipe and the ductile iron piping manufacturer recommendations.

a. Where requirements from the manufacturer, requirements specified by the DIRPA Installation Guide, and requirements specified herein differ, apply the most stringent requirement of the three.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. Buried piping submittals shall be submitted under the specification section number corresponding to the buried piping material. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Shop Drawings:

1) Catalog cuts and data sheets, including but not limited to:

a) Specifications for all components of the buried piping.

b) Illustrations in sufficient detail to serve as a guide for assembly and disassembly

c) A parts schedule that identifies the materials to be used for the various piping components and accessories.

d) Weights of all component parts.

e) Details on joining methods.

f) Details of pipe lining, coating, wrapping, insulation and painting.

g) Copy of details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances (pipe couplings, specials, and adapters shall be submitted for approval under Section 40 05 06- Couplings, Adapters, and Specials for Process Piping).

b. Layout and Installation Drawings:

1) Shall include plans, sections, and details showing location, elevations, and clearly marked dimensions.

2) Piece numbers which are coordinated with the tabulated pipe layout schedule shall be clearly marked.

3) The scale used shall be the greater of the following two (2) scales:

   a) The scale used on the Contract Drawings that depict the process pipe for which the submittal pertains.

   b) ¼-in = 1-ft - 0-in.

4) When special designs or fittings are required, the work shall be shown in large detail and the special or fitting completely described and dimensioned.

5) Include a north arrow.

6) Information on pipe supports, including:

   a) Pipe support location.

   b) Pipe support type.

   c) Thrust block details.

   d) All loads on the support (in either lbs. or kips.)

7) Location of pipe couplings, specials, and adapters.

8) Extent of lining, wrapping, and coatings.

c. A tabulated pipe layout schedule for each buried process pipe system. Submit a separate schedule for each pipe system and/or service. The pipe layout schedule shall include the following information for each pipe section, fitting, and appurtenance that comprises that system:

1) Service.

2) Pipe size.

3) Working pressure.

4) Weight (in lbs.)

5) Joint type.

6) Wall thickness.

7) Piece number.

8) Laying length.

d. Calculations for the design of the support structures.

1) Design calculations shall be signed and sealed by a Professional Engineer registered in the State of New York.

2) Calculations shall include a summary of design criteria used in the design, including a description of each load case and load combination considered.

3) A tabulation shall be provided giving the column vertical and horizontal reactions for each load combination.

2. Information Submittals:

a. Certified Letters of Compliance:

1) Certificate of compliance with the requirements of the Contract Documents for pipe, fittings, couplings, sleeves, cleanouts and harnessing.

2) Linings and Coatings:

a) Manufacturer shall submit a certificates or copies thereof attesting to the fact that the applicator met the requirements of the corresponding piping specification, adherence to all standards and testing specified therein, and that the material used was as specified therein.

3) Materials Certificates of Conformance: Submit certificates of conformance with Referenced Standards specified in the corresponding piping specification section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Polyethylene Underground Warning Tape:

1. Brady Corp., Milwaukee, WI;

2. Marking Services, Inc., Milwaukee, WI;

3. Seton Identification Products, Branford, CT;
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Warning Tape:

1. General:
   a. Tracer tape shall be of inert, acid- and alkali-resistant polyethylene.
   b. All tape shall be suitable for direct burial.
   c. Message:
      1) Shall read as follows: "CAUTION [Potable water, storm, or sanitary] PIPE BURIED BELOW"
      2) Shall be written with bold letters 2-in. high.
      3) Messages shall be printed at maximum intervals of 2 ft.
      4) Tape shall be custom colored per the Utility Color Codes in the 811 NY Excavator Manual.
2. For Metallic Pipelines:
   a. Size:
      1) Thickness: 4 mils.
      2) Width: 6-in.
   b. Tape shall:
      1) Be capable of stretching to twice its original length.
3. For Non-Metallic Pipelines:
   a. Size:
      1) Thickness: 5 mils.
      2) Width: 6-in.
   b. Tape shall:
      1) Have aluminum backing.
      2) Have 15,000 psi tensile strength.
      3) Have 140% elongation capability.

B. Polyethylene Encasement:

1. Provide polyethylene encasement for all buried ductile iron piping to prevent contact between pipe and surrounding bedding material and backfill.
2. Provide polyethylene encasement in accordance with AWWA C105.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation.

1. Immediately remove defective materials from the Site and replace with acceptable products.

B. All pipe coating injured in any way during transit or laying shall be satisfactorily repaired prior to placing the backfill.

1. Ample provision shall be made for the prompt and efficient repair of all abrasions and injuries.

C. Inspect interior of all pipes, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed and wiped clean and dry immediately before pipe is laid.

3.02 INSTALLATION

A. General:

1. All piping shall be erected to accurate lines and grades, supported as shown, specified, or required.

a. Slope piping uniformly between elevations shown.

2. Where temporary supports are used during construction, sufficient strength and rigidity shall be provided to prevent shifting or distortion of the pipe.

3. All work shall be accomplished using the best methods and procedures of recognized pipe fabrication in a good and workmanlike manner in accordance with the latest edition of the applicable standards referenced in the Contract Documents, including (but not limited to):

a. For ductile iron pipe:

1) AWWA C105

2) AWWA C600.

3) AWWA M41.

b. For thermoplastic pipe:

1) ASTM D2321.

2) AWWA M23.

4. All buried pipe, fittings, and appurtenances shall be installed in accordance with all of the following:

a. The manufacturer's printed instructions and recommendations.

b. The approved shop drawings.

c. As specified in the Contract Documents.

5. Routing:

a. Install piping in a neat manner with lines straight and parallel or at right angles to building walls or structures, unless otherwise shown on the Contract Drawings.

1) Install horizontal lines true to line and elevation.

2) Install vertical lines truly plumb in all directions.

b. Where practicable, install piping in groups and parallel to building walls or structures.

c. Clearance:

1) Clearances shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.

d. Small diameter piping and/or piping not shown on the Contract Drawings:

1) If specific locations and elevations are not shown on the Contract Drawings, install small diameter piping as specified herein, and as necessary and required to avoid obstructions.

6. Cuts:

a. Use cutting methods and machines specially designed for cutting the pipe material and approved by the manufacturer. The following cutting methods are not acceptable:

1) "Squeeze" type pipe cutters

2) Cutting torches

3) Diamond points

4) Dog chisels.

b. Pipe Lengths:

1) Full standard lengths of pipe shall be used in each pipe run in so far as possible.

2) Shorter lengths than standard shall be used only to complete a straight run of pipe, to connect to established locations of valves, equipment, bends, and the like.

3) Random lengths of pipe or cuttings from standard lengths shall not be coupled together when a full standard pipe length will fit in the pipe run.

c. Pipe shall be cut square, and not upset, undersized, or out of round, except as follows:

1) Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth.

d. Ends shall be carefully reamed and cleaned before being installed.

e. Make cuts carefully without damage to coatings or linings.

7. Excavation:

a. Trench excavation shall conform to the requirements of Section 31 23 16 - Excavation, as applicable.

b. Dewater trench before pipe installation in accordance with Section 31 23 19 - Dewatering.

1) Keep groundwater level in trench at least 24-in. below bottom of pipe before laying pipe.

2) Do not lay pipe in water.

3) Maintain dry trench conditions until jointing and backfilling are complete.

4) Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.

c. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.

d. Excavate around joints in bedding as necessary and required to complete joint connection.

8. Placing:

a. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

b. For coated pipe, care shall be exercised in laying and cradling the pipe to prevent injury to the coating.

c. Start laying pipe at lowest point and proceed towards higher elevations.

1) On steep slopes, prevent movement of pipe during installation.

d. Lay pipe so that pipe barrel bears uniformly on trench bottom.

e. Exercise care to avoid flotation when installing pipe in cast in-place concrete, and in locations with high groundwater.

f. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.

g. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.

h. Install bell and spigot pipe so that bells face the direction of laying, unless otherwise shown on the Contract Drawings.

i. Allow extra length at future connection points to be cut to fit after backfill and prior to tie-in.

j. Notify the Engineer prior to installing pipe into trench and allow time for Engineer's inspection.

k. The Contractor shall correct irregularities found during inspection.

l. Complete tie-ins within trench whenever possible to prevent overstressed connections.

9. Bedding:

a. Backfill shall conform to the requirements of Section 31 23 23 - Fill, as applicable.

b. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.

10. Jointing:

a. Thoroughly clean all pipe, fittings, valves, specials, and accessories before jointing.

1) Remove all cuttings and foreign matter from inside of pipe and tubing.

2) Clean joining area of pipe, fittings, and appurtenances as necessary and required and as per manufacturer instructions.

a) For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.

b. Use jointing methods recommended and approved by the pipe manufacturer.

c. Transitions from One Type of Pipe to Another:

1) Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

2) Connections between Dissimilar Metals:

a) Provide dielectric couplings, insulating couplings, unions, or other approved dielectric insulating devices, at all connections to pipelines or equipment of dissimilar metals, regardless of whether devices are shown on the Contract Drawings.

11. Bends and Turns:

a. Bends shall be of 45° or 90° unless otherwise shown on the Contract Drawings.

b. Pipe Flexibility:

1) Do not bend pipe to greater degree than minimum radius recommended by the pipe manufacturer for type and grade.

2) Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.

12. Plugs:

a. Shall match the materials, linings, and coatings of the process piping, and shall have a square head.

13. Transitions:

a. Reducing fittings shall be used for all changes in pipe sizes, even when not specifically shown on the Contract Drawings.

1) Unless otherwise shown or specified, use eccentric reducing fittings.

b. Do not use bushings or nipples for buried piping.

c. Between pressure ratings:

1) Where lines of lower service rating tie into services, appurtenances, or equipment of higher service rating, the equipment, valve, or appurtenance between the two shall conform to the higher rating.

14. Restraints, Supports, and Thrust Blocks:

a. Provide concrete and metal cradles, collars, kickers, and blocks as shown on the Contract Drawings or as necessary and/or required to provide thrust restraint.

15. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:

a. At the end of each day of work or other interruption of pipe installation, the Contractor shall provide temporary blind flanges, plugs, caps, or bulkheads as necessary and required.

1) Plug all bells at dead ends, tees, and crosses.

2) Cap all spigot and plain ends.

b. To perform the testing of buried piping as specified herein, or as per the sequence of work specified in the Contract Documents, the Contractor shall provide temporary blind flanges, line stops, plugs, and bulkheads suitable for and capable of withstanding the services and pressures for which they are intended.

1) Refer to Section 33 06 01 - Schedule for Buried Piping, for service and test pressures.

2) Temporary blind flanges, line stops, plugs, and bulkhead shall be compatible with and shall not damage the piping materials, coatings, and linings specified in Section 33 06 01 - Schedule for Buried Piping.

c. The Contractor shall uninstall all temporary blind flanges, plugs, caps, and when they are no longer needed for the Work.

B. Ductile Iron Pipe:

1. Cutting:

a. Where field cutting of ductile iron pipe is permitted by the Engineer, ductile iron pipe shall be cut only by means of abrasive saws, hack saws, wheel type cutters or milling type cutters.

2. End Connections:

a. Mechanical Joint:

1) Ensure that cut ends are tapered and sharp edges are filed off smooth. Thoroughly clean the plain end (spigot) and the socket of the pipe or fitting.

2) Brush the socket, spigot end, gasket, and adjacent areas immediately before making joint with soapy water in accordance with AWWA C111.

3) Slip the gland and gasket over the spigot with the small side of the gasket facing the socket and the lip side of the gland facing the socket.

4) Insert the spigot into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

5) Slide the gland towards the socket and center it around the pipe with the gland lip against the gasket.

6) Insert bolts and tighten nuts by hand.

7) With an ordinary ratchet wrench, tighten bolts evenly and alternately around. The pattern for tightening bolts shall be as per the manufacturer's recommendations. The bolt torque for mechanical joints shall be as per the DIPRA Installation Guide.

8) Do not deflect mechanical joint pipe after installation.

b. Push-On Joint:

1) Ensure that the spigot (plain) end is beveled as per the manufacturer’s recommendations and that sharp edges are filed off smooth.

a) Use a heavy file or grinder to bevel the plain end.

b) Do not use a saw blade to bevel the plain end.

2) Thoroughly clean the groove and the bell socket of the pipe or fitting. Also clean the plain end of the mating pipe or fitting.

3) Except for pipe lined or coated, use a wire brush to clean the exterior surface of the spigot and the interior surface of the bell.

a) Use a method for cleaning coated or lined portions of the pipe recommended by the coating or lining manufacturer.

4) Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.

a) Use a rubber gasket recommended by the pipe manufacturer.

(1) Do not use gaskets that have been scored or otherwise damaged.

b) Wipe clean rubber gaskets and flex gaskets until resilient. follow the manufacturer instructions for gasket resiliency when assembling joints in cold weather.

c) As per the DIPRA Installation Guide, make at least one (1) small loop and then insert the gasket into the socket.

(1) For pipe sizes larger than 20-in. nominal diameter, it may be necessary to make two loops in the gasket opposite each other.

(2) Make sure the gasket faces the correct direction as per the manufacturer's instructions and that it is properly seated.

5) Apply lubricant as per the manufacturer recommendations to the surface of the gasket that will come in contact with the entering spigot. Also apply lubricant to the outside of the entering spigot.

a) As per the DIPRA Installation Guide, do not apply lubricant to the bell socket or the surface of the gasket in contact with the bell socket.

6) Push the spigot end into the bell socket of the mating pipe or fitting, ensuring the joint remains straight.

a) Pause insertion when the spigot end just makes contact with the rubber gasket.

b) After the gasket is compressed and before the pipe is inserted completely, carefully check the gasket for proper position around the full circumference of joint.

c) Final assembly shall be made by inserting the spigot end of the entering pipe past the gasket until it makes contact with the base of the bell.

7) Deflect push-on joint pipe only after the joint is assembled and not exceeding the deflection shown on the Contract Drawings and the maximum deflection specified in the DIPRA Installation Guide for the nominal diameter of pipe in question.

c. Grooved / Shouldered End Joints:

1) Grooved and shouldered end joints and their installation shall conform to the requirements of AWWA C606.

2) Thoroughly clean the joint ends to remove foreign matter. Except for coated pipe, use a wire brush to clean the exterior surface of the joint ends.

a) Use a method for cleaning the coated portion of the pipe recommended by the coating manufacturer.

3) Remove the bolts from the coupling.

4) Apply lubricant to the rubber gasket or inside of the coupling housing and joint ends as per the manufacturer recommendations.

5) Position and install the gasket over the gap between the joint ends.

6) Install the coupling housing around the gasket and over the grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand.

7) Tighten the bolts uniformly and according to the manufacturer's instructions.

d. Flanged Connections:

1) All flange faces shall be in perfect alignment with the holes straddling the vertical center line of the piping.

2) Properly center the gasket. Use full-face gaskets for flat-face flanges.

3) Gaskets shall be suitable for the service conditions referenced in Section 33 06 01 - Schedule for Buried Piping.

4) The gasket thickness shall be as recommended by the pipe manufacturer, with the exception that:

5) The minimum gasket thickness for raised face flanges shall be ⅛-in.

6) Bolts shall be of sufficient length so that when fully tightened, a minimum of two full threads shall extend beyond the nut.

7) Bolts shall be well lubricated over the entire thread length with a heavy graphite and oil mixture prior to the tightening operation.

8) Bolts shall be tightened with proper wrenches, care being taken to secure uniform pressure on the bolts and gasket and to avoid over stressing of the bolts, dishing of the flanges and compression of the gasket beyond its proper limits.

a) Commercial grade carbon steel bolts, ASTM A307, Grade B shall be tightened to obtain approximately 15,000 psi stress based on the root area of the thread.

b) Alloy steel bolts, ASTM A193, Grade B7 shall be tightened to obtain a stress of 45,000 psi.

c) The pattern for tightening bolts shall be as per the manufacturer's recommendations.

3. Support:

a. Ductile iron below floors that is not to be encased in concrete:

1) Where ductile iron pipe shall be buried below floor structures, the pipe shall be supported by concrete encased adjustable clevis hangers anchored to the floor by means of bearing plates.

a) Supports shall conform to the requirements of Section 40 05 07 - Hangers and Supports for Process Piping.

b) Hangers shall be spaced not more than 5 ft apart.

C. PVC Pipe Installation

1. End Connections:

a. Solvent-Welded Joints:

1) Make all solvent-welded PVC joints in accordance with ASTM D2855 and the solvent manufacturer's approved instructions.

2) Use primers and solvent cements meeting the requirements of ASTM F656 and ASTM D2564, respectively.

3) Do not make solvent cement joints if temperature is below 40°F.

4) Do not make solvent cement welded joints in wet conditions.

5) The following procedure shall be followed to ensure proper gluing of PVC pipe.

a) Ensure the end of the pipe is beveled.

b) Apply primer to the female end.

c) Apply primer to the male end.

d) Reapply primer to the female end; the primer must not dry.

e) Apply glue to the male end using an appropriately sized brush.

f) Apply glue with the brush to the female end.

g) Reapply glue to the male end.

h) Join the male and female ends with a quarter turn twist and hold for 30 sec.

6) After joint assembly, wipe excess cement from the pipe. A properly made joint will show a bead around the entire

circumference. Any gaps in this bead indicate a defective joint, and the Contractor shall remake such joints at no additional cost to the DEP.

D. Separation of Sewers and Potable Water Piping:

1. Requirements for the separation of sewers and potable water piping apply to all buried piping installation, regardless of piping materials.

2. In the event that the requirements specified herein differ from separations shown on the Contract Drawings and/or differ from separations required by Authorities Having Jurisdiction, the more stringent (i.e., greater separation distance) shall apply.

3. The Contractor shall install all buried potable water piping and sewers with the following separations:

a. For water mains installed parallel to sewers:

1) Where the depth to the bottom of the sewer cradle is less than 10 ft, the clearance between the outside of the water main and the centerline of the existing sewer should be not less than 6 ft plus one-half the sewer diameter.

2) Where the depth to the bottom of the sewer cradle is 10 ft or more, the clearance between the outside of the water main and the centerline of the existing sewer shall be increased 1 ft for each additional 5 ft of depth over 10 ft, or portion thereof.

b. For water mains crossing sewers:

1) Wherever the clearance between the top of an existing sewer and the bottom of the proposed water main, at their crossing, is less than 1 ft, the water main is to be supported by a truss arrangement and the clearance space is to be filled with layers of compressible material to avoid excessive bearing pressure on the sewer pipe.

a) In no case, however, should this clearance be less than 6 in..

3.03 FIELD TESTING / QUALITY CONTROL

A. Test all buried piping in accordance with the requirements of Section 33 05 05.30 - Leakage Testing for Buried Piping.

B. Visual Inspection:

1. Pipes 30-in. and greater in diameter shall be visually tested by entering and recording direct measurements.

2. For pipes less than 30-in. in diameter with runs no longer than 100 ft, visually inspect from pipe end (lamping).

C. Videotape Inspection:

1. All installed buried pipes shall be visually inspected by video, or closed circuit television (CCTV).
2. Video inspection shall be submitted to the Engineer for review and approval.
3. The Contractor shall make installation modifications requested by the Engineer based on final visual and CCTV inspection.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 33 06 01 – SCHEDULE FOR BURIED PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all buried piping as indicated in the buried piping schedule, complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	2
PART 2	PRODUCTS	2
2.01	Manufacturers	2
2.02	Materials / Equipment	2
2.03	Fabrication / Assembling / Finishes	2
2.04	Source Quality Control / Shop Tests	2
PART 3	EXECUTION	2
3.01	Examination / Preparation	2
3.02	Installation	2
3.03	Field Testing / Quality Control	3
3.04	Startup / Demonstration	3
3.05	Adjusting / Protection / Cleanup	3

A. The following schedule(s), attached after the end of section designation, are a part of this Section:

1. Schedule 33 06 01-1, Schedule of Buried Piping.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 33 05 05 – Buried Piping Installation

B. Section 33 05 05.30 – Leakage Testing for Buried Piping

1.04 REFERENCES

A. Not Used

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Not Used

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SCHEDULE 33 06 01-1
BURIED PIPING SCHEDULE

Service Name	Material	Wall Thickness/ Schedule/ Class	Type of Joint	Working Pressure (psig)	Test Type	Test Pressure Head (ft)	Interior Coating	Exterior Coatings, Treatments	Remarks
Storm Sewer	RCP	Class IV	RG/BS	##	HYD	n/a	--	--	--
Underdrain (Porous Pavement)	Perforated PVC	Sch 40	SW	##	HYD	n/a	--	--	--
Force Main	DI	Class 56	RPOJ	60	HYD	200	CEL	PE & AC	CEL thickness shall be minimum forty (40) mills thick.
Water Service Lateral	DI	Class 56	RMJ/RPOJ	140	HYD	200	CL	PE & AC	CL thickness shall double the minimum thickness specified in AWWA C104/A21.4. Pipe shall comply to C151/A21.51 – Ductile Iron Pipe Centrifugally Cast
Storm Sewer for Interim Pumping Station	RCP	Class IV	RG/BS	##	HYD	n/a	--	--	--

A. The following service abbreviations are used in Schedule 33 06 01-1:

Service:	**Abbrev:**	**Service:**	**Abbrev:**
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--

B. The following pipe material abbreviations are used in Schedule 33 06 01-1:

Pipe Material:	**Abbrev:**	**Pipe Material:**	**Abbrev:**
304L Stainless Steel	304L SS	Ductile Iron	DI
316L Stainless Steel	316L SS	High-Density Polyethylene	HDPE
Brass	Brass	Polyvinyl Chloride	PVC
Carbon Steel	CS	Prestressed Concrete Cylinder Pipe	PCCP
Chlorinated PVC	CPVC	Reinforced Concrete Pipe	RCP
Copper	Cu	Stainless Steel	SS

C. The following joint type abbreviations are used in Schedule 33 06 01-1:

Joint Type:	**Abbrev:**	**Joint Type:**	**Abbrev:**
Bell and Spigot	BS	Soldered	Sld
Brazed	Brz	Solvent Weld	SW
Butt Weld	BW	Restrained Mechanical Joint	RMJ
Flanged	Flg	Restrained Push-on Joint	RPOJ
Lap Welded	LW	Threaded	Thd
Mechanical Joint	MJ	Welded	Wld
Push-on Joint	POJ	Rubber Gasket	RG

D. The following interior coating abbreviations are used in Schedule 33 06 01-1:

Interior Coating	**Abbrev:**	**Interior Coating:**	**Abbrev:**
Asphalt Coated	AC	Cement Lined	CL
Basalt Coated	BC	EPDM (M-class) Rubber	EPDM
Ceramic Epoxy Coated	CEC	Glass Lined	GL
Ceramic Epoxy Lined	CEL	Polyethylene Lined	PEL

E. The following exterior coating and treatment abbreviations are used in Schedule 33 06 01-1:

Exterior Coating, Treat.:	**Abbrev:**	**Exterior Coating, Treat.:**	**Abbrev:**
Asphalt Coated	AC	Galvanized	Galv
Epoxy	Epx	Polyethylene Encasement	PE

F. The following testing abbreviations are used in Schedule 33 06 01-1:

Test Type:	**Abbrev:**	**Test Type:**	**Abbrev:**
Exfiltration	Exf	Infiltration	Inf
Hydrostatic	Hyd	--	--

SECTION 33 39 10 – SANITARY AND STORM SEWER STRUCTURES

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Requirements for furnishing and installing precast and cast-in-place manholes, catch basins, trench drains, and other structures in sanitary sewers and storm sewers including all appurtenances.

B. Concrete drainage structures include, but are not limited to, inlets, catch basins, trench drains, manholes, pipe cradles and encasements, and splash pads.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A.	Section 03 21 00	-	Reinforcing Steel
B.	Section 03 30 00	-	Cast-in-Place Concrete
C.	Section 05 56 00.01	-	Miscellaneous Metal Castings
D.	Section 33 05 05.30	-	Leakage Tests for Buried Piping

1.04 REFERENCES

A.	ASTM C32	-	Sewer and Manhole Brick (Made from Clay or Shale)
B.	ASTM C39	-	Standard Test Method for Compressive Strength for Cylindrical Concrete Specimens
C.	ASTM C78	-	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
D.	ASTM C139	-	Concrete Masonry Units for Construction of Catch Basins and Manholes
E.	ASTM C140	-	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
F.	ASTM C144	-	Aggregate for Masonry Mortar
G.	ASTM C279	-	Chemical-Resistant Masonry Units
H.	ASTM C443	-	Joints for Concrete Sewer and Manholes, Using Rubber Gaskets
I.	ASTM C478	-	Circular Precast Reinforced Concrete Manhole Sections
J.	ASTM C666	-	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing Freeze Thaw Stability of Concrete Specimens
K.	AWWA C302	-	Reinforced Concrete Pressure Pipe, Non-cylinder Type
L.	City of New York Department of Environmental Protection Sewer Design Standards		

1.05 DESCRIPTION

A. Design Requirements

1. Except as otherwise shown or specified, construct sewer manholes and catch basins of precast reinforced concrete sections conforming to ASTM C478.

2. Unless otherwise shown, manholes and catch basins shall be built in accordance with the latest version of the New York City Department of Environmental Protection Sewer Design Standards and Standard Sewer and Water Main Specifications, except that they shall be constructed without steps.

3. Trench drains shall be constructed of precast, interlocking modular components.

B. Construction of Manholes

1. Manhole Base Section: Unless otherwise shown, provide manhole base sections consisting of a base riser section with an integral floor. When benches are made at the manufacturing site, provide concrete used for benched inverts conforming to the requirements for concrete used for precast sections. When benches are made in the field, Class 45 concrete may be used. Benches shall be float finished and sloped to drain.

2. O-ring Joints: Join riser, cone and flat slab top sections with O-ring rubber gasket joints or self-sealing butyl gaskets, as shown in the Sewer Design Standards. Fill voids in the joints completely with mortar after assembly of the sections.

C. Precast Products

1. Unless otherwise shown or specified, precast concrete products shall be used for sanitary and storm sewer structures.

2. The number of joints in manhole and catch basin riser sections shall be kept to a minimum by using sections 8'-0" long in so far as possible. Joints shall be tongue and groove type conforming to AWWA C302, with continuous steel reinforcement in the tongue and bell.

3. Wet-cast methods only shall be used. Forms shall leave the surfaces smooth and free of irregularities or honeycombing.

4. Unless otherwise shown or specified, the following design loadings shall be used with 30 percent impact allowance in roads and 15 percent elsewhere.

   a. Earth = 130 pcf

   b. Wheel = H-20

5. Unless otherwise shown or specified, wall thickness for manholes and catch basins shall be not less than:

   a. 5 inches for walls

   b. 8 inches for top slab

6. No more than two (2) tapered lifting holes shall be provided per section of manhole or lifting holes shall be filled with tapered rubber plugs.

7. The point of intersection (P.I.) of pipes shall be marked with a pin in the manhole floor.

8. The date of manufacture and the manufacturer’s trademark shall be marked inside each manhole and catch basin barrel.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. Shop and field test reports of concrete samples tested in an approved laboratory.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Take every precaution to prevent injury to the structures during transportation and unloading. Unload manhole sections and other precast items using skids, pipe hooks, rope slings, or suitable power equipment, if necessary, and keep the items under control at all times. Do not allow the items to be dropped, dumped or dragged under any conditions. Follow applicable requirements specified in Contract Documents Damaged Section: If any precast manhole section or other structural unit is damaged in the process of transportation or handling, reject and immediately remove the item from the Site, and replace it at no increase in Contract Amount.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Precast Manholes shall be as manufactured by:

1. Monarch Precast Concrete Corp., Allentown, PA;
2. Precast Concrete Sales Company, Valley Cottage, NY;
3. Long Island Precast, Inc., Holtsville, NY;
4. Or approved equal.

B. Precast Inlets shall be as manufactured by:

1. Monarch Precast Concrete Corp., Allentown, PA;
2. Penn-Cast Products, Inc., Fredericksburg, VA;
3. Precast Concrete Sales Company, Valley Cottage, NY;

4. Or approved equal.

C. Precast Catch Basins shall be as manufactured by:

1. Monarch Precast Concrete Corp., Allentown, PA;
2. Penn-Cast Products, Inc., Fredericksburg, VA;
3. Long Island Precast, Inc., Brookhaven, NY;
4. Precast Concrete Sales Company, Valley Cottage, NY;
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Concrete, Steel Reinforcement and Aggregates: For precast manholes, catch basins, inlets, and other sanitary and storm sewer structures, reinforced concrete, cementitious materials, aggregates and steel reinforcement shall conform to the requirements of ASTM C478. If concrete rings are used for adjusting manhole frames to grade, they shall conform to the requirements of ASTM C139. For cast-in-place structures, these materials shall conform to Sections 03 30 00 – Cast-in-Place Concrete and 03 21 00 – Reinforcing Bars.

B. Brick: If brick is used for adjusting manhole and catch basin frames to grade, it shall conform to ASTM C32, Grade MS, with minimum dimensions of 2 1/4 by 3 1/2 by 7 1/2 inches. Brick shall be new, solid, sound, hard burned throughout and uniform in size and quality.

C. Mortar: Provide mortar that is composed of one part Type II Portland cement or Portland pozzolan cement to two parts sand. Sand shall be natural sand that conforms to the requirements of ASTM C144.

D. Frames and Covers: Frames, covers, gratings and miscellaneous metal castings shown in the Sewer Design Standards or on the Contract Drawings for installation on manholes, catch basins, trench drains and other sanitary structures shall be gray iron and shall meet the requirements of Section 05 56 00.01 - Miscellaneous Metal Castings. Grating for trench drains shall be compatible with the trench drain manufacturer's systems and recommendations.

E. O-Ring Rubber Gaskets: Provide O-ring rubber gaskets conforming to ASTM C443 for joining manhole sections.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Concrete Strength: Manhole sections will be inspected and tested by an independent, certified testing laboratory, retained by the DEP, to establish the strength of the concrete and the adequacy of curing, to certify the date that the sections were cast and to confirm that the reinforcing steel has been properly

placed. This inspection and testing will be performed by the laboratory at the manufacturing plant prior to shipment.

1. A minimum of one set of three cylinders will be taken each day that manhole sections are cast, with batch samples to be designated by the laboratory representative. At least one set of cylinders will be taken from each 9 cubic yards of concrete used in manhole section construction. These samples will be tested for strength. If the samples fail to meet specified minimum concrete strength requirements, all manhole sections manufactured from the concrete from which the cylinders were made will be rejected.
2. The DEP reserves the right to core manholes either at the job Site or point of delivery to validate strength of concrete and placement of steel. If cores fail to demonstrate the required strength or indicate incorrect placement of reinforcing steel, all sections not previously tested will be considered rejected until sufficient additional cores are tested, at no increase in Contract Amount, to substantiate conformance to these requirements.

B. Acceptance of flat slab tops will be based on the tops passing a proof-of-design test in accordance with ASTM C478. One flat slab top for each design shall be tested.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Manhole Frames: Firmly embed manhole frames in mortar. Provide wedges or shims for accurate and level placing of the frames.

B. Connections to Riser Section: Manufacture riser sections with openings properly located for making connections to sewers. The minimum distance between a joint in a manhole section and the nearest edge of an opening for a connecting sewer and the diameter of such openings shall be as shown in the Sewer Design Standards.

C. Coatings: No exterior coating shall be used for precast structures.

D. Laying Masonry:

1. Bricks shall be wetted before applying mortar.
2. Full bed, end and side joints shall be formed in one operation.
3. Horizontal joints shall be 3/8 inch maximum and radial joints shall be 1/4 inch maximum.
4. Keyways shall be completely filled with mortar.

5. The total amount of adjustment by bricks or concrete rings shall not exceed 12 inches.

E. Precast Items:

1. Place on crushed stone bed or concrete cradle set level as shown.

2. Place backfill in even lifts on all sides to prevent overturning loads.

F. Stubs for Future Connections: Where shown, provide stubs or bells cast in walls and provide approved plugs or caps.

G. Grading:

1. Manholes and catch basins shall be installed such that covers will be at final grade.

2. Structures shall not project above finished pavements.

3. Structures in areas with temporary working grades shall be initially installed to match the temporary grade, and adjusted later to final grade prior to regrading.

4. Contractor shall be responsible for setting structures to the proper grade. The Engineer's review will be general and will apply to components only.

3.03 FIELD TESTING / QUALITY CONTROL

A. Test for leakage as required by Section 33 05 05.30 – Leakage Tests for Buried Piping.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 33 42 10 - REINFORCED CONCRETE SEWER PIPE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish and install reinforced concrete sewer pipe, fittings and specials.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	9
3.01	Examination / Preparation	9
3.02	Installation	9
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	10
3.05	Adjusting / Protection / Cleanup	10

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 33 05 05.30 - Leakage Testing for Buried Piping

B. Section 33 06 01 - Schedule for Buried Piping

C. Section 03 30 00 - Cast-in-Place Concrete

1.04 REFERENCES

A. ASTM A283 - Low and Intermediate Tensile Strength Carbon Steel Plates

B.	ASTM A1011	-	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
C.	ASTM B127	-	Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
D.	ASTM C31	-	Making and Curing Concrete Test Specimens in the Field
E.	ASTM C39	-	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
F.	ASTM C76	-	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
G.	ASTM C361	-	Reinforced Concrete Low-Head Pressure Pipe
H.	ASTM C443	-	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
I.	ASTM C497	-	Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
J.	AWWA C302	-	Reinforced Concrete Pressure Pipe, Noncylinder Type

1.05 DESCRIPTION

A. Design Requirements

1. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete, and when tested at the end of 28 days shall have the following minimum compressive strengths:

   a. PRECAST PIPE - 5,000 psi

   b. CRADLES AND ENCASEMENT - 3,500 psi

2. Design: Provide the classes of reinforced concrete sewer pipe as shown or specified. Conform pipe designs to the following requirements.

   a. Use diameter, wall thickness, compressive strength of concrete and area of circumferential reinforcement as prescribed for Classes I to IV in Tables 1 to 5 in ASTM C76, except do not use Wall A thickness, elliptical reinforcing cages or quadrant reinforcing mats. Do not substitute modified designs for designs shown in the tables.

   b. Provide special designs only for pipe with diameters and loads beyond those shown in Tables 1 to 5, pipe diameters that do not have steel reinforcement areas shown in the tables and pipe subject to thrust forces encountered in jacking operations. Conform special designs with the requirements of Section 7.2.2 of ASTM C 76, except do not use Wall A thickness, elliptical reinforcing cages or

quadrant reinforcing mats without prior approval. Retain a Registered Professional Engineer, licensed in the State of New York, to prepare, sign and seal all special designs for pipe.

3. Precast reinforced concrete pipe shall conform to the requirements of ASTM C76 for circular steel reinforcement and the three-edge bearing strength test requirements for the load to produce the 0.01 inch crack and for the ultimate load. When the strength test requirements specified in the Contract Documents are greater than the strength test requirements of ASTM C76, the thickness of the pipe wall may be increased, the area of circular steel reinforcement increased, or a combination of these, all as approved by the Engineer.

4. Joints:

   a. Provide joints for pipe, fittings and specials in gravity sewer and drain lines meeting the requirements of ASTM C443 and this Specification.

   b. Provide joints for pipe, fittings and specials in concrete pressure lines with test pressures of 125 ft. or less meeting the requirements of ASTM C361 and these specifications.

   c. Provide joints for pipe, fittings and specials in concrete pressure lines with test pressures over 125 ft. as described in the Contract Documents.

B. Schedules

1. Refer to Section 33 06 01 – Schedule for Buried Piping and the Contract Documents for information on the piping that is to be constructed using the pipe materials and methods specified herein.

1.06 QUALITY ASSURANCE

A. General: Provide concrete pipe, fittings and specials that are precast or machine made and are the product of a company that can demonstrate by tests and installation records satisfactory experience in manufacturing concrete pipe of the quality and type specified.

1.07 SUBMITTALS

A. The Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited to:

1. All diameters and classes of reinforced concrete pipe, fittings and specials and for concrete sills showing dimensions, strength and materials specifications and standards, joint details and reinforcement position

2. Area of all cages of reinforcing steel

3. A minimum clearance of one inch for each cage of circumferential reinforcing steel shown

4. Angle of the joint

5. Length and thickness of bell and spigot
6. Length and thickness of joint
7. Manufacturer, size and type of gasket
8. Manufacturer's recommendations for gap dimension and tolerance for a properly installed pipe joint
9. Signature and title of authorized representative of the manufacturer
10. All requirements of the latest ASTM Specifications for Precast Reinforced Concrete Pipe as called for in the Contract Documents will be complied with in the manufacture of the pipe

B. Joint Compliance: Submit notarized affidavit of joint compliance with ASTM C443 and the Contract Documents for each pipe size. The statement shall include date of test.

C. Quality Control: Submit certified results of all shop tests for approval.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not ship pipe to the site of the work until the pipe test results are certified by the Engineer.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Reinforced Concrete Pipe

1. Manufacture:

a. Do not use admixtures or blends in concrete without prior approval.

b. The manufacturer shall maintain a satisfactory manufacturing schedule and shall have adequate storage facilities so that the Work will not be delayed.

c. Cast pipe in steel forms to the exact dimensions shown, specified or required. Unless otherwise shown or specified, the inner and outer

rings of reinforcement shall be concentric. Provide chairs and spacers to insure and maintain the proper position of reinforcement steel with respect to the protective concrete covering. Pipes in which reinforcing steel is placed beyond the tolerances allowed by ASTM C76 will be rejected. Use metal spacers at the top between the inner and outer forms to maintain uniform wall thickness in casting pipe. Where reinforcement mesh is used in the pipe, curve such reinforcement to shape on rolls having grooves for the longitudinal wires. In casting pipe, do not cut wires for form spacers or for other purposes. Provide continuous internal vibration of concrete during the pouring operation.

d. The Contractor will be responsible for meeting all requirements for the manufacture of precast pipe and checking at regular intervals all of such requirements.

2. Lengths: Manufacture all reinforced concrete pipe in lengths of not more than 16 feet and not less than 8 feet as follows, except where shorter lengths are required and approved for pipeline curves or at junctions with structures.

a. Furnish subaqueous pressure pipe in lengths of not less than 16 feet for pipe up to and including 84 inches in diameter. Pipe larger than 84 inches in diameter may be of lengths less than 16 feet, decreased on a sliding scale in accordance with the manufacturer's recommendations and as approved by the Engineer.

b. Furnish pressure pipe to be installed inland in lengths not less than 12 feet, except that pipe to be laid in sheeted trench shall be furnished in lengths not less than 8 feet.

3. Labeling: Immediately after the stripping of forms, all pipe manufactured for the Department of Environmental Protection as required under this contract shall be marked and identified with the following data: DEP, contract name and number, class and diameter of pipe, number of pipe, date of manufacture and the name of the manufacturer. The numbering of the pipe shall be consecutive for each diameter of pipe. Brass lettering templates designed to stencil this information on each pipe shall be provided by the pipe manufacturer. The aforementioned data shall be stenciled on the inside and outside of each length of pipe with waterproof ink or paint. Any pipe arriving at the location of the work without this information stenciled thereon will be rejected. At the end of each day of casting of the pipe, the manufacturer shall forward to the Engineer three copies of a report giving the diameters and the respective numbers of pipe cast that day.

B. Reinforced Concrete Fittings and Specials

1. General: Provide reinforced concrete fittings and specials where shown, specified or required, and manufactured in accordance with the applicable sections of the respective standard for the adjoining pipe. Provide joints the same as in the adjoining pipe. Provide the interior surface of bends of the

same smoothness and diameter as the adjoining pipe. Provide the center line radius of curvature of bends to be equal, in dimension, to the inside diameter of the pipe.

2. Strength: Design all reinforced concrete fittings and specials to have the same strength as the class of the adjoining pipe. Retain a Registered Professional Engineer, licensed in the State of New York to prepare, sign and seal all designs for fittings and specials.

3. Standard fitting such as bends, tees, wyes and reducers shall be formed of steel, cut, shaped and welded to the proper form. Interior and exterior concrete or mortar shall be placed in approved manner.

4. Special pieces and openings in standard pipe such as closures, wall fittings, adapters, manholes, air valve outlets, blow-offs and branches shall conform to details approved by the Engineer.

C. Joints

1. General: Rubber gaskets shall be stored in as cool a location as practicable, preferably at 70 degrees F or less. In no case shall gaskets be exposed to the direct rays of the sun for a total of more than 24 hours.

2. Gravity Sewer and Drain Lines:

a. Manufacture all gravity sewer and drain pipe, fittings and specials with watertight joints using rubber gaskets in accordance with the requirements of ASTM C443. Provide a preformed groove in the tongue or spigot of sufficient depth to hold the gasket securely in place and produce the proper gasket compression. Reinforced concrete pipe joints shall be optional as to shape, except that no joint shall have a groove in which the wall thickness of the pipe is reduced to less than one-half, other than by a slight draw or taper, unless approved by the Engineer in writing.

b. Manufacture the pipe with perfectly machined castings for forming the bells and spigots so that they will be true circles and when laid together the annular space for the rubber gasket will be perfectly uniform. The diameters of the bell and spigot surfaces, depended upon to compress the gasket, shall not vary from the theoretical diameters by more than 1/16 inch. The joint shall not project beyond the body of the pipe.

c. Reinforce the bells of the pipe with a single cage of steel in which the circumferential members are the same gauge as those in the body of the pipe, but spaced on no more than 1 inch centers.

d. The type and the manufacturer of the flexible rubber gaskets to be used shall be submitted for approval before pipe laying begins.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop Testing

1. Test concrete sewer pipe in accordance with the applicable provisions of ASTM C497, as required by the ASTM Specification for the pipe and as specified herein.

2. Test cylinders: Each day the Contractor shall prepare two test cylinders made from the concrete used for manufacturing the pipe under this contract.

    a. Make test cylinders in accordance with the requirements of ASTM C31 and cure and store them under identical conditions with the pipe. Test cylinders shall be properly marked for identification and dated.

    b. The Engineer will have the cylinders tested to determine whether the concrete complies with the strength requirements. Of each pair of test cylinders, one cylinder will be tested at 7 days, and the other test cylinder will be tested at 28 days. Test cylinders will be tested in accordance with ASTM C39 and the cost of such tests will be borne by the DEP.

3. Test Pipe Sections:

    a. When lengths of pipe are 8 feet or less, the Engineer will select one length from every fifty lengths of each diameter and class.

    b. When lengths of pipe are more than 8 feet, the Contractor shall provide a pipe test specimen four feet long for every 50 lengths of each diameter and class. Each test specimen shall be manufactured, marked for identification and shall meet the strength test requirements as specified for the pipe it represents. The manufacturing and marking of the pipe test specimen shall be witnessed by the Engineer.

    c. Where less than 50 lengths are required for any pipe diameter, one eight-foot length of pipe will be selected by the Engineer or one pipe test specimen shall be provided for testing purposes; however, the Engineer may waive this requirement at his discretion.

    d. Age of Pipe: Pipe selected or pipe tested specimens provided as specified for testing purposes shall be at least twenty-eight days old but shall not be over thirty days old at the time of testing.

        1) Due to unforeseen conditions beyond the control of the Engineer and the manufacturer, special permission will be given in writing by the Engineer to delay a test beyond the 30 day aging period.

        2) The three-edge load bearing strength at 0.01-inch crack and the ultimate load strength of pipe tested after twenty-eight days will be corrected to the 28 day strength by deducting 1/2 of one percent of the recorded strength for each day beyond the twenty-eight day age.

3) The Contractor may request tests to be made on pipe which has aged at least fourteen days and not more than 28 days but the tests must meet the 28 day strength test requirement in order to be accepted by the Engineer for installation in the work.

4. Basis of Acceptance: Conform the basis of acceptance for reinforced concrete pipe to Section 5.1.1 of ASTM C76 and this Section.

   a. The Engineer will reject all pipe of the lot which the tested length of pipe represents if the actual or corrected strength of the pipe tested fails to meet the three-edge load bearing strength test requirements. However, if the eight-foot length of pipe selected by the Engineer fails to meet the three-edge loading bearing strength test requirements, the Contractor may request that tests be made on two other eight-foot lengths of pipe representing that lot from which the original pipe tested was selected. The Engineer will select these two lengths of pipe. Should the tests on these two lengths of pipe prove satisfactory, the lot, represented by these lengths of pipe will be accepted. Should the tests on one or two of these lengths of pipe prove unsatisfactory, no further tests on any other lengths of pipe from this lot will be made, and all the pipe in this particular lot will be rejected.

   b. The Engineer may accept precast pipe which meets the 0.01-inch crack strength test requirements but does not meet the ultimate load strength test requirements; however, the DEP will deduct 1/2 of one percent of the price bid per linear foot for that item which covers that particular pipe diameter and test strength requirements, for each one percent by which the ultimate load is below the required ultimate load. This deduction will be made on all pipe represented by the test specimen.

5. Proof-of-Adequacy Tests for Special Designs: Prior to manufacturing production run pipe of special design, test one pipe of at least four feet in length of each diameter and class by the three-edge-bearing method to confirm that the pipe meets both the 0.01-inch crack and ultimate load requirements for which it is designed.

6. Joint Adequacy Tests:

   a. Prior to manufacturing production run pipe, fittings and specials, conduct all tests required by Sections 9 and 10 of ASTM C443 for each diameter of pipe.

   b. Give two weeks' notice in writing, before the day of testing, to both the Engineer and the approved laboratory, to witness the tests. The Department of Environmental Protection reserves the right to have an inspector or authorized representative present at the time of the tests.

c. All manufacturers supplying reinforced concrete pipe to the Department of Environmental Protection shall, for each size of pipe and gasket combination submitted for approval, have on file with the Department a Certified Statement attested thereto by the DEP inspector or representative that the hydrostatic test on pipe and on rubber gasket was performed in accordance with the above-mentioned ASTM designation and passed.

7. Location of Tests: The pipe selected or the pipe test specimen provided for test shall be delivered by the Contractor to an approved testing laboratory and removed by the Contractor after the test has been made. The Contractor may request that tests be made at the manufacturer's plant; however, the pipe manufacturer shall provide an approved and certified testing machine with a hydraulically-operated jack and direct-reading gauges requiring no calibration.

8. Test Witnessing: All strength tests will be witnessed by the Engineer.

9. Costs of Tests: The Contractor shall pay all costs associated with tests and test witnessing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install all reinforced concrete sewer pipe, fittings and specials in accordance with the manufacturer’s recommendations and approved shop drawings, and as follows.

1. Precast pipe lines shall be true to line and grade. The interior surface shall be smooth and uniform.

2. Season pipe 28 days prior to laying.

3. With the gasket in place, align the pipe, and draw the joints home with an approved tackle and apparatus. Prior to the use of such apparatus and method, demonstrate to the Engineer for approval the effectiveness and practicability of the proposed method of drawing the joints home.

4. The position and condition of the gasket will be examined from the inside of the pipe before successive pipe lengths are installed. If an unsatisfactory condition is located, the pipe shall be taken out and the operation of drawing the pipe together repeated with a new gasket.

5. Provide approved concrete sills for the temporary support of pipes which are to be permanently supported on concrete cradles for maintaining proper alignment and grade until the concrete cradle is poured. Completely embed such sills in the concrete cradle.

6. Cast concrete cradles for pipe in one pour to the exact size and dimensions shown on the Contract Drawings.

B. Jointing Pipe at Structures:

1. At manholes and other structures in precast concrete pipe lines, the construction may be of monolithic concrete. Submit details of such joints to the Engineer for approval.

2. Where precast concrete pipe for pressure pipe lines is joined to monolithic concrete pipe, cast iron or steel pipe, or other structure, the joint shall be similar to the joint between individual precast concrete pipes, enlarged if required. Submit details of such joints to the Engineer for approval.

3. Where provisions for future connections are required, provide similar joints and coat with an approved asphaltic compound for protection. If necessary, in the opinion of the Engineer, place a suitable collar entirely around the pipe at all such joints.

3.03 FIELD TESTING / QUALITY CONTROL

A. Test the reinforced concrete sewers for leakage after completion in accordance with Section 33 05 05.30 - Leakage Testing for Buried Piping.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 05 05.30 – LEAKAGE TESTING FOR EXPOSED PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to test all exposed piping completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	3
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Implementation	4
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 51 11 – Temporary Water and Sanitary Services

B. Section 01 75 10 – Preliminary and Final Field Tests

C. Section 40 05 05 – Exposed Piping Installation

D. Section 40 06 01 – Schedule for Exposed Piping

1.04 REFERENCES

A. Definitions:

1. Buried Piping: Includes all piping beginning at the outside face of a structures or foundation and extending away from structures. Buried piping includes piping beneath structures or foundations.

2. Exposed Piping: Includes all piping beginning at the outside face of a structures or foundation and extending inside. Exposed piping also includes all piping embedded in concrete, as well as all piping that is permanently or intermittently submerged and/or installed in a subaqueous environment.

B. Reference Standards:

1. AWWA C600-10 Installation of Ductile-Iron Mains and Their Appurtenances

2. Section 312 of The New York City Plumbing Code.

1.05 DESCRIPTION

A. This scope of this Section includes the requirements for the testing of exposed piping, except where testing requirements for exposed piping are shown or specified elsewhere in the Contract Documents.

B. All exposed pipelines for which testing requirements are specified in this Section shall be watertight or airtight, including, but not limited to:

1. All exposed piping and appurtenances installed under Section 40 05 05 - Exposed Piping Installation.

2. All exposed piping and appurtenances installed under other Sections, but that specify testing under this Section.

C. Piping and structures which fail leakage tests shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Engineer. These repaired piping and structures shall then be retested at the Contractor's expense until leakage test results meet the requirements specified herein.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. Exposed piping testing submittals shall be submitted under the specification section number corresponding to the exposed piping material. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Testing Procedures:

1) Submit proposed testing procedures, methods, apparatus, and sequencing.

2) Testing procedures shall be submitted for approval at least 30 ccd prior to the test.

b. Testing Report:

1) Prior to placing the piping system or structure in service, submit for review and approval a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

2. Informational Submittals:

a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.

b. Results of each specified field quality control test.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. The Contractor shall provide all labor, equipment, air, water and materials, including meters, gauges, blower, pumps, compressors, hoses, fuel, water, bulkheads, temporary bracing and restraints, valves, plugs, and accessory equipment necessary and required to complete the testing as specified herein.

B. Testing medium:

1. The Contractor shall provide all air or gasses necessary or required for testing.

2. Unless otherwise specified, the existing facility shall provide all water required for testing.

a. The Contractor shall provide all means to convey the fluid into the piping being tested.

3. Refer to the Contract Drawings, Section 01 51 11 - Temporary Water and Sanitary Services and Section 01 75 10 - Preliminary and Final Field Tests for availability of water to be used for testing.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Notification:

1. Provide the Engineer with written notice at least 14 consecutive calendar days prior to the date of testing.

a. No tests shall be conducted without an approved written procedure.

b. The Engineer shall respond in writing to the Contractor within 7 consecutive calendar days of receiving the written notification.

B. All leakage tests shall be conducted in the presence of the Engineer.

1. All leakage tests shall be conducted in the presence of local authorities having jurisdiction, if required.

C. Remove or protect devices and appurtenances that could be damaged by testing.

D. Concealed pipelines:

1. Test all pipelines prior to concealment.

3.02 IMPLEMENTATION

A. General:

1. Perform leakage testing for all exposed piping in accordance with the requirements of Section 40 06 01 - Schedule for Exposed Piping, except piping explicitly shown or specified as exempted from testing. For pipelines not listed in Section 40 06 01- Schedule for Exposed Piping:

a. Test all pipelines not listed in Section 40 06 01 - Schedule for Exposed Piping via a hydrostatic test with clean water.

b. Test vents and drains in plumbing systems and plumbing pipe lines in accordance with Section 312 of the New York City Plumbing Code, unless otherwise specified. Unless specified otherwise, test all vents and drains on process piping as for plumbing systems.

2. Operation of Existing Facilities:

a. Conduct all tests in a manner to minimize interference with operations of existing facilities or other contractors working on the site.

B. Hydrostatic Testing:

1. Application:

a. Exposed pipelines:

2. Test Procedure:

a. Maintain the testing medium at the specified pressure for a period of 4 hrs.

1) Unless otherwise specified, the testing medium shall be clean water.

2) Do not use air for hydrostatic testing of pipelines intended for liquid service – use compressed air (or gas) only for the hydrostatic testing of air (or gas) pipelines.

b. Test the piping as a whole or in sections.

1) The Contractor shall use valves or install temporary bulkheads at the ends of each section.

2) Remove temporary bulkheads at the conclusion of the hydrostatic testing.

c. Apply the specified hydrostatic test pressure to the piping through a tap in the pipe by means of a pump, compressor, or other approved method.

3. Test Pressures:

a. Test the pipeline at the pressure specified in Section 40 06 01 - Schedule for Exposed Piping.

b. If no test pressure is specified for a hydrostatic test, submit a test pressure of 1.5 times the maximum possible operating pressure of the pipeline, for approval by the Engineer

Leakage:

a. The allowable leakage shall not exceed the testing allowance given by the following formula from AWWA Standard C600:

$$L = \frac{S \cdot D \cdot \sqrt{P}}{148{,}000}$$

Where: L = testing allowance (makeup water) (gph).
S = length of pipe tested (ft).
D = nominal diameter of the pipe, (in.).
P = average test pressure during the hydrostatic test (psig).

5. Repair:

   a. Replace broken pipe or joint assemblies found to leak.

   b. When leakage occurs in excess of the specified amount, locate and repair defective valves, pipe, cleanouts or joints.

   c. If defective portions cannot be located, remove and reconstruct as much of the original work as necessary to obtain piping that meets the leakage requirements specified herein and retest, all at no additional cost to the DEP.

C. Hydrostatic Testing of Valves:

1. Test Procedure:

   a. Prior to the application of the test pressure, operate the valve(s) through the number of complete cycles of closing and opening recommended by the manufacturer.

   b. Next, apply the test pressure to one side of the valve (i.e., the first side).

      1) The valve shall be in the closed position.

      2) Introduce the liquid testing medium to the first side only and apply the test pressure.

         a) The other side of the valve(s) (i.e., the second side) shall be dry and unpressurized (0 psig).

      3) Maintain the testing medium at the specified pressure for a period of 4 hrs.

   c. Then, reverse the side to which the test pressure is applied.

      1) The valve shall still be in the closed position.

      2) Now apply the test medium and pressure to the other side of each valve (i.e., the second side).

      3) The side tested first (i.e., the first side) shall now be unpressurized (0 psig).

      4) Maintain the testing medium at the specified pressure again for a minimum period of 4 hrs.

   d. Hydrostatic testing of valve(s) may be concurrent with hydrostatic testing of pipeline section(s) to the extent permissible by the testing requirements specified herein.

   e. The Contractor shall be responsible for draining and disposing of the test medium in accordance with the requirements of the Contract Documents, as necessary and required to test both sides of each valve in this manner.

2. Test Pressure:

a. Hydrostatic test each valve such that the differential pressure across the valve at the same test pressure specified for the pipe in which the valve is installed.

3. Leakage:

a. Stop all external and internal leakage through the valves.

b. No leakage across the valve shall be acceptable.

4. Movement:

a. Stop all valve movement or structural distress.

b. No movement of the valve is acceptable.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 05 05 – EXPOSED PIPING INSTALLATION
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required, to install all exposed piping completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	8
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	9
3.03	Field Testing / Quality Control	26
3.04	Startup / Demonstration	26
3.05	Adjusting / Protection / Cleanup	26

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete.

B. Section 05 12 00 – Structural Steel Framing.

C. Section 40 05 05.30 – Leakage Testing for Exposed Piping.

D. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

E. Section 40 05 07 – Hangers and Supports for Process Piping.

F. Section 40 05 15 – Copper and Brass Process Pipe.

G. Section 40 05 19 – Ductile Iron Process Pipe.

H. Section 40 05 53 – Process Valves Four-inch Diameter and Larger.

I. Section 40 05 56 – Process Valves, Smaller than Four-inch Diameter.

J. Section 40 05 96 – Vibration and Seismic Controls

K. Section 40 05 97 – Identification for Process Equipment.

L. Section 40 06 01 – Schedule for Exposed Piping.

1.04 REFERENCES

A. Definitions:

1.	Buried Piping:	Includes all piping beginning at the outside face of a structures or foundation and extending away from structures. Buried piping includes piping beneath structures or foundations.
2.	Exposed Piping:	Includes all piping beginning at the outside face of a structures or foundation and extending inside. Exposed piping includes interior piping. Exposed piping also includes all piping embedded in concrete, as well as all piping that is permanently or intermittently submerged and/or installed in a subaqueous environment.

B. Reference Standards:

1.	ANSI/SMACNA	Seismic Restraint Manual.
2.	ASME B1.1	Unified Inch Screw Threads.
3.	ASME B31.3	Process Piping.
4.	ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
5.	ASTM B32	Standard Specification for Solder Metal
6.	ASTM D2564	Standard Specification for Solvent Cements for PVC Plastic Piping Systems.
7.	ASTM D2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining PVC or CPVC Pipe and Piping Components with Tapered Sockets.
8.	ASTM F493	Standard Specification for Solvent Cements for CPVC Plastic Pipe and Fittings.

9.	ASTM F656	Standard Specification for Primers for Use in Solvent Cement Joints of PVC Plastic Pipe and Fittings.
10.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
11.	AWWA C206	Field Welding of Steel Water Pipe.
12.	AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances.
13.	AWWA C606	Standard for Grooved and Shouldered Joints.
14.	AWWA C651	Disinfecting Water Mains.
15.	AWWA M11	Steel Pipe: A Guide for Design and Installation,
16.	AWWA M23	PVC Pipe – Design and Installation.
17.	AWWA M41	Ductile-Iron Pipe and Fittings.
18.	DIPRA	Installation Guide for Ductile Iron Pipe.
19.	NSF61	Drinking Water System Components Health Effects.

1.05 DESCRIPTION

A. This scope of this Section includes the requirements for the installation of exposed piping, except where installation requirements for exposed piping are shown or specified elsewhere in the Contract Documents. In addition:

1. The scope of this Section includes requirements for:

   a. The jointing of exposed piping

   b. The installation of gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, and tie rods.

   c. Modifications and/or adjustments to existing exposed piping.

   d. The installation of supports, restraints, and other anchors.

   e. The cleaning, disinfecting, and field testing of all exposed piping.

2. The diameters and extent of exposed process piping is shown on the Contract Drawings. The Contractor shall provide additional exposed pipe as necessary and/or required to complete the Work as shown and specified. Exposed pipe service, pipe diameter, coating, lining, pressure rating, joint type, and testing requirements are specified in the following section(s):

   a. Section 40 06 01 - Schedule for Exposed Piping.

3. Where shown on the Contract Drawings, the Contractor shall provide all labor and materials for making connections between exposed piping and

existing lines(s) installed under other contracts, including all specials required to connect exposed pipe to pipe of dissimilar material(s).

1.06 QUALITY ASSURANCE

A. Ductile Iron Pipe:

1. Refer to the latest edition of the DIPRA Installation Guide for Ductile Iron Pipe and the ductile iron piping manufacturer recommendations.

a. Where requirements from the manufacturer, requirements specified by the DIRPA Installation Guide, and requirements specified herein differ, apply the most stringent requirement of the three.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. Exposed piping submittals shall be submitted under the specification section number corresponding to the exposed piping material. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Shop Drawings:

1) Catalog cuts and data sheets, including but not limited to:

a) Specifications for all components of the exposed piping.

b) illustrations in sufficient detail to serve as a guide for assembly and disassembly

c) A parts schedule that identifies the materials to be used for the various piping components and accessories.

d) Weights of all component parts.

e) Details on joining methods.

f) Details of pipe lining, coating, wrapping, insulation and painting.

g) Copy of pipe coupling, special, and adapter details (pipe couplings, specials, and adapters shall be submitted for approval under Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping).

h) Copy of expansion joint details (expansion joints shall be submitted for approval under the specification section in which they are specified)

i) Copy of pipe hanger details (pipe hangers shall be submitted for approval under Section 40 05 07 - Hangers and Supports for Process Piping).

b. Layout and Installation Drawings:

1) Shall include plans, sections, and details showing location, elevations, and clearly marked dimensions.

2) Piece numbers which are coordinated with the tabulated pipe layout schedule shall be clearly marked.

3) The scale used shall be the greater of the following two (2):

a) The scale used on the Contract Drawings that depict the process pipe for which the submittal pertains, or

b) A minimum scale of ¼-in = 1-ft - 0-in.

4) When special designs or fittings are required, the work shall be shown in large detail and the special or fitting completely described and dimensioned.

5) Include a north arrow.

6) Information on pipe supports, including:

a) Pipe support location.

b) Pipe support type.

c) hanger rod size.

d) Insert type.

e) All loads on the support (in either lbs. or kips.)

7) Locations where pipe and valve identification signs will be placed.

8) Location of pipe couplings, specials, and adapters.

9) Location of expansion joints.

10) Locations of pipe hangers and supports.

11) Extent of lining, wrapping, and coatings.

c. A tabulated pipe layout schedule for each exposed process pipe system. Submit a separate schedule for each pipe system and/or service. The pipe layout schedule shall include the following information for each pipe section, fitting, and appurtenance that comprises that system:

1) Service.

2) Pipe size.

3) Working pressure.

4) Weight (in lbs.)

5) Joint type.

6) Wall thickness.

7) Piece number.

8) Laying length.

d. Calculations for the design of the support structures.

1) Design calculations shall be signed and sealed by a Professional Engineer registered in the State of New York.

2) Calculations shall include a summary of design criteria used in the design, including a description of each load case and load combination considered.

3) A tabulation shall be provided indicating vertical and horizontal deflections for the supports and individual members, determined for each load combination identified above.

4) A tabulation shall be provided giving the column vertical and horizontal reactions for each load combination.

e. For each exposed process piping system that contains expansion and swing joints, submit EMA calculations. Submit separate calculations for each pipe system and/or service.

f. For each exposed process piping system that contains valves, submit a tabulated valve schedule. Submit a separate schedule for each pipe system and/or service. The valve schedule shall include the following information for each valve:

1) Valve tag number.

2) Valve size.

3) Whether the valve is manual or actuated. If actuated, the type of actuator.

4) 100% open Cv value for control valves.

5) Upstream pressure (units of psig).

2. Information Submittals:

a. Certified Letters of Compliance:

1) Certificate of compliance with the requirements of the Contract Documents for pipe, fittings, couplings, sleeves, cleanouts and harnessing.

2) Certificate from an independent testing laboratory, approved by DEP, for each welder assigned to the welding of pipe, fittings, and pipeline equipment.

3) Linings and Coatings:

a) Manufacturer shall submit a certificates or copies thereof attesting to the fact that the applicator met the requirements of the corresponding piping specification, adherence to all standards and testing specified therein, and that the material used was as specified therein.

4) Materials Certificates of Conformance: Submit certificates of conformance with Referenced Standards specified in the corresponding piping specification section.

b. Welding Procedures and Qualifications:

1) Certificates shall be of current issue and conform to the requirements of the applicable reference standards. In addition:

a) Certificates that all welders and welding operators have been qualified in accordance with ASME Boiler and Pressure Vessel Code Section IX.

2) Copies of qualified procedures and list of names and identification symbols of qualified welders and welding operators, prior to welding operations.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Site to ensure uninterrupted progress of the Work.

B. Upon Delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.

C. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.

D. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.

E. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.

F. Keep pipe interiors free of dirt and foreign matter.

G. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Structural Attachments:

1. Structural steel brackets required to support piping and appurtenances but not shown on the Contract Drawings shall be provided under this Section and in accordance with Section 40 05 07 – Hangers and Supports for Process Piping.

2. Material for structural attachments shall be as specified under Section 05 12 00 - Structural Steel Framing.

B. Piping materials are specified in the piping schedule in the Section 40 06 01 – Schedule for Exposed Piping. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Identification:

1. Provide in accordance with Section 40 05 97 - Identification for Process Equipment.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. All pipe coating injured in any way during transit or laying shall be satisfactorily repaired prior to placing the backfill.

1. Ample provision shall be made for the prompt and efficient repair of all abrasions and injuries.

B. Certificates of welding qualifications conforming to the requirements of ASME B31.1, Section 6 and its Supplements, shall be submitted to the Engineer for approval prior to proceeding with any pipe welding.

3.02 INSTALLATION

A. General:

1. All piping shall be erected to accurate lines and grades, permanently supported as shown, specified, or required.

2. Where temporary supports are used during construction, sufficient strength and rigidity shall be provided to prevent shifting or distortion of the pipe.

3. All work shall be accomplished using the best methods and procedures of recognized pipe fabrication in a good and workmanlike manner in accordance with the latest edition of the applicable standards referenced in the Contract Documents, including (but not limited to):

a. For ductile iron pipe:

1) AWWA C600.

2) AWWA M41.

4. All exposed pipe, fittings, and appurtenances shall be installed in accordance with all of the following:

a. The manufacturer's printed instructions and recommendations.

b. The approved Shop Drawings.

c. As specified in the Contract Documents.

d. If there is a conflict between manufacturer’s recommendations and the Contract Documents, request in writing instructions from Engineer before proceeding.

5. Routing:

a. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines, unless otherwise shown on the Contract Drawings.

1) Install horizontal lines true to line and elevation.

2) Install vertical lines truly plumb in all directions.

b. Where practicable, install piping in groups and parallel to building walls.

c. Avoid installing piping through ductwork or directly under electric light outlets, or interfering with other pipe, lines, conduit, etc.

d. Leave all corridors, walkways, work areas, and similar spaces unobstructed.

e. Clearance:

1) Clearances shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.

2) Provide a minimum clearance of 1-in. between pipe and other work.

3) Avoid installing pipe beyond furring lines as determined by the Architectural Drawings.

4) Unless otherwise approved by Engineer or shown on Contract Drawings, provide a minimum headroom clearance under piping and pipe supports of 7.5 ft.

f. Small diameter piping and/or piping not shown on the Contract Drawings:

1) If specific locations and elevations are not shown on the Contract Drawings, install small diameter piping as specified herein, and as necessary and required to avoid ducts, equipment, beams, and other obstructions.

g. Multiple Pipe Runs:

1) In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member.

2) Spacing of the base support members shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run.

6. Placing:

a. Install bell and spigot pipe so that bells face the direction of laying, unless otherwise shown on the Contract Drawings.

b. For coated pipe, care shall be exercised in laying and cradling the pipe to prevent injury to the coating.

7. Cuts:

a. Use cutting methods and machines specially designed for cutting the pipe material and approved by the manufacturer. The following cutting methods are not acceptable:

1) "Squeeze" type pipe cutters

2) Cutting torches

3) Diamond points

4) Dog chisels.

b. Pie Lengths:

1) Full standard lengths of pipe shall be used in each pipe run in so far as possible.

2) Shorter lengths than standard shall be used only to complete a straight run of pipe, to connect to established locations of valves, equipment, bends, and the like.

3) Random lengths of pipe or cuttings from standard lengths shall not be coupled together when a full standard pipe length will fit in the pipe run.

c. Pipe shall be cut square, and not upset, undersized, or out of round, except as follows:

1) Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth.

d. Ends shall be carefully reamed and cleaned before being installed.

e. Make cuts carefully without damage to coatings or linings.

8. Jointing:

a. Thoroughly clean all pipe, fittings, valves, specials, and accessories before jointing.

1) Remove all cuttings and foreign matter from inside of pipe and tubing.

2) Clean joining area of pipe, fittings, and appurtenances as necessary and required and as per manufacturer instructions.

a) For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.

b. Use jointing methods recommended and approved by the pipe manufacturer.

c. Unions:

1) Provide a union downstream of each valve with screwed connections.

2) Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

d. Transitions from One Type of Pipe to Another:

1) Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

2) Connections between Dissimilar Metals:

a) Provide dielectric couplings, insulating couplings, unions, or other approved dielectric insulating devices, at all connections to pipelines or equipment of dissimilar metals, regardless of whether devices are shown on the Contract Drawings.

b) Refer to Section 40 05 15 - Copper and Brass Process Pipe, for additional requirements for dielectric insulating devices for use with copper and brass process pipe.

9. Bends and Turns:

   a. Do not spring or deform piping to make up joints.

   b. Bending of pipe is not permitted.

      1) Use fittings for all changes in direction.

   c. Bends shall be of 45° or 90° unless otherwise shown on the Contract Drawings.

10. Plugs:

   a. Shall match the materials, linings, and coatings of the process piping, and shall have a square head.

11. Transitions:

   a. Reducing fittings shall be used for all changes in pipe sizes, even when not specifically shown on the Contract Drawings.

      1) Unless otherwise shown or specified, use eccentric reducing fittings.

   b. Do not use bushings, except where specifically shown on the Contract Drawings.

   c. Nipples shorter than 4-in in length shall be Schedule 80.

   d. Between pressure ratings:

      1) Where lines of lower service rating tie into services, appurtenances, or equipment of higher service rating, the equipment, valve, or appurtenance between the two shall conform to the higher rating.

12. Drainage:

   a. The Contractor shall provide all pipelines with a means for drainage at all low points in the lines.

      1) Provide appurtenances for condensate drainage, regardless of whether such means is shown on the Contract Drawings and/or the approved Shop Drawings.

   b. Drainage valves and appurtenances shall be:

1) A minimum of 1-in. nominal diameter, unless otherwise shown on the Contract Drawings.

2) Adequately sized.

3) Of the same size as the drain pipeline specified herein.

4) Meet the requirements of Section 40 05 56 - Process Valves, Smaller than Four-inch Diameter.

c. Where drainage valves or appurtenances are located so that liquids can discharge and cause damage to a structure or equipment, the Contractor shall provide drain pipe to the nearest gutter or drain.

1) Provide a single drain pipe, matching the size of the drain valve and appurtenances, for each drain valve on the carrier pipe.

2) Unless otherwise shown on the Contract Drawings, the drain pipe shall be of Schedule 80 CPVC conforming to the requirements of Section 40 05 31 - Thermoplastic Process Pipe and the installation requirements for thermoplastic piping specified herein.

3) A quick connect coupling shall be provided at the end of the drain line for attachment of a hose.

13. Venting:

a. The Contractor shall provide all pipelines for liquids with vents at all high points in the lines.

1) Provide vents regardless of whether vent valves are shown on the Contract Drawings and/or the approved shop drawings.

b. Vents shall consist of the following three (3) components:

1) An automatic air release/vacuum relief valve.

a) The valve shall have a cast or ductile-iron body and cover, stainless steel internals, and Viton or Buna N seal, unless otherwise specified.

2) An outlet vent line.

a) The outlet vent line from the valve shall be of Schedule 80 CPVC conforming to the requirements of Section 40 05 31, Thermoplastic Process Pipe and the installation requirements for thermoplastic piping specified herein.

b) Vent line shall terminate at a point approximately 3 ft above the floor.

3) An isolation ball valve:

a) A ball valve shall be provided between the carrier pipe and the automatic air/vacuum release valve to allow removal of the automatic air/vacuum release valve for repair or replacement.

b) The body of the isolation valve shall be:

(1) For vents < 4-in.: Type 316 Stainless Steel.

(2) For vents ≥ 4-in.: The same material as the body of the automatic air/vacuum release valve.

c. Sizing:

1) For carrier pipelines ≤ 1-in.: Vents shall be the same size as the carrier pipe.

2) For carrier pipe > 1-in.: Vents shall be the size shown on the Contract Documents or 1-in., whichever is greater.

d. Vent valves (both the automatic air/vacuum release and isolation valve) shall meet the requirements of one (1) of the following Sections, depending on the size of the vent valve:

1) Section 40 05 53 - Process Valves Four-inch Diameter and Larger.

2) Section 40 05 56 - Process Valves, Smaller than Four-inch Diameter.

14. Drip Pans:

a. The Contractor shall provide drip pans under all pipelines installed over electrical equipment and motors and conduct drainage to the nearest floor drain, gutter, or other drainage system with ¾-in. red brass pipe conforming to the requirements of Section 40 05 15 - Copper and Brass Process Pipe, and installed as specified herein.

b. Make the connection between the drip pan and the brass drain pipe leak-tight.

c. Pitch the drip pan uniformly toward the drain pipe at a slope not less than ⅛-in. per lineal ft.

15. Hangers and Supports:

a. Install pipelines with supporting devices in accordance with requirements of Section 40 05 07 - Hangers and Supports for Process Piping.

b. No piping shall be supported from metal stairs, ladders and walkways.

16. Restraints, Supports, and Thrust Blocks:

a. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.

b. Provide concrete and metal cradles, collars, kickers, and blocks as shown on the Contract Drawings.

c. Restrained Pipe Joints:

1) Pipe joints shall be restrained by means suitable for the type of pipe being installed.

a) Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a restrained joint system as specified in Section 40 05 19. Ductile Iron Process Pipe, lugs, and tie rods, or other joint restraint systems. approved by Engineer. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

b) Steel Pipe Joints: Provide butt-welded joints, lap welded joints, flanged joints, or mechanical coupling connections as shown and specified in Exposed Piping Schedule. Provide tie rods connected to lugs welded to the steel pipe for restraint at mechanical couplings.

c) Thermoplastic Joints: Where non-restrained joints are utilized, provide tie rods across the joint or other suitable joint restraint system, subject to approval of the Engineer.

17. Seismic Requirements:

a. All piping and attached valves shall be supported and braced to resist seismic loads and in accordance with the SMACNA Seismic Restraint Manual.

18. Expansion and Contraction:

a. The Contractor shall provide ample provisions for flexibility in all pipelines to compensate for expansion and contraction.

1) Unless other forms of expansion compensation are shown or specified, the Contractor shall:

a) Provide lengths of pipe shorter than the theoretical length to the extent of one half of the expansion, and install said lengths of pipe such that they may be free to expand without increasing the stresses imposed when cold.

2) Otherwise, the Contractor shall install all piping with expansion devices to allow for proper expansion and contraction.

a) Expansion devices shall allow the pipe to expand and contract freely without damage to any part of the piping system.

b) Expansion devices shall include, but not be limited to: expansion joints, expansion couplings, swivel or swing joints or pipe bends, including such anchors as may be shown, specified, or required to make the devices effective.

b. Cold sprung pipe:

1) Install with metal filler pieces bolted between flanges or tack welded between weld joints.

2) After the pipe, anchors, hangers and supports have been installed, the spacers shall be removed and the joint made.

c. Swing Joints:

1) For pipelines 2-in. nominal diameter or smaller, rated at working pressures up to 150 psig:

a) Screwed end swing or swivel joints may be used.

b) Otherwise expansion shall be taken up with nipples and fittings as required.

2) A sufficient number of fittings and pipe lengths in connection with swing joints shall be provided to assure the absence of distortion of either the pipelines or branches.

d. Branch Tees:

1) Install branch tees on risers in locations that will allow the branch lines, when expanded by heat, to drain properly.

e. Pipe Expansion Bends:

1) Pipe bends of approved design for compensating thermal expansion when shown, specified or required shall be fabricated and furnished as herein specified.

2) In pipelines operating under high pressures or high temperatures in which offsets occur in alignment that may be subject to bending stresses excessive for the fittings, or where otherwise deemed necessary, use appropriate pipe bends to make the offset.

3) Where possible, all bends shall have radii equal to a least six diameters ($r = 6 \times d$) of the pipe and tangents or straight

lengths of the pipe shall be neatly made, true to radius, free from buckles and flat surfaces.

f. Application guide and anchor requirements for expansion joints shall be in accordance with the recommendations of the manufacturer or the Standards of the EJMA.

g. The Contractor shall adjust all expansion devices after installation (but prior to operation) so that the pipelines shall be fluid-tight through the full range of operating conditions.

19. Wall Sleeves:

a. Where piping passes through walls, partitions, floors, roofs, or structures, provide wall sleeves of wearing material to prevent abrasion damage to piping.

1) Pipe sleeves shall be ductile iron.

2) Sleeves through walls shall be flush with wall face.

b. Anchor sleeves to concrete and masonry walls as shown on the Contract Drawings.

c. All annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.

d. Do not install sleeves and pipes through structural members unless specifically shown on the Contract Drawings.

20. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:

a. At the end of each day of work or other interruption of pipe installation, the Contractor shall provide temporary blind flanges, plugs, caps, or bulkheads as necessary and required.

1) Plug all bells at dead ends, tees, and crosses.

2) Cap all spigot and plain ends.

b. To perform the testing of exposed piping as specified herein, or as per the sequence of work specified in the Contract Documents, the Contractor shall provide temporary blind flanges, line stops, plugs, and bulkheads suitable for and capable of withstanding the services and pressures for which they are intended.

1) Refer to Section 40 06 01 - Schedule for Exposed Piping, for service and test pressures.

2) Temporary blind flanges, line stops, plugs, and bulkhead shall be compatible with and shall not damage the piping materials, coatings, and linings specified in Section 40 06 01 - Schedule for Exposed Piping.

c. The Contractor shall uninstall all temporary blind flanges, plugs, caps, and when they are no longer needed for the Work.

21. Flow Measuring Devices:

    a. If not shown on the Contract Drawings, position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the manufacturer, unless specific location dimensions are shown.

B. Ductile Iron Pipe:

1. Cutting:

    a. Where field cutting of ductile iron pipe is permitted by the Engineer, ductile iron pipe shall be cut only by means of abrasive saws, hack saws, wheel type cutters or milling type cutters.

2. End Connections:

    a. Flanged Connections:

        1) All flange faces shall be in perfect alignment with the holes straddling the vertical center line of the piping.

        2) Properly center the gasket. Use full-face gaskets for flat-face flanges.

        3) Gaskets shall be suitable for the service conditions referenced in Section 40 06 01 - Schedule for Exposed Piping.

        4) The gasket thickness shall be as recommended by the pipe manufacturer, with the exception that:

        5) The minimum gasket thickness for raised face flanges shall be ⅛-in.

        6) Bolts shall be of sufficient length so that when fully tightened, a minimum of two full threads shall extend beyond the nut.

        7) Bolts shall be well lubricated over the entire thread length with a heavy graphite and oil mixture prior to the tightening operation.

        8) Bolts shall be tightened with proper wrenches, care being taken to secure uniform pressure on the bolts and gasket and to avoid over stressing of the bolts, dishing of the flanges and compression of the gasket beyond its proper limits.

            a) Commercial grade carbon steel bolts, ASTM A307, Grade B shall be tightened to obtain approximately 15,000 psi stress based on the root area of the thread.

            b) Alloy steel bolts, ASTM A193, Grade B7 shall be tightened to obtain a stress of 45,000 psi.

c) The pattern for tightening bolts shall be as per the manufacturer's recommendations.

3. Support:

a. Provide supports for exposed ductile iron piping, fittings, appurtenances, and specials in accordance with the requirements of Section 40 05 07 - Hangers and Supports for Process Piping. In addition:

1) Where shown on the Contract Drawings, ductile iron pipe beneath the ground floors of buildings or structures shall be encased in concrete to form an integral part of the floor slab.

a) This piping shall be included in the definition of exposed piping.

b) The reinforcement in the floor slab shall be placed and bent so that the pipe encasement is an integral part of the concrete structure.

c) Concrete for encasement:

(1) Shall be class 40.

(2) Shall conform to the requirements of Section 03 30 00 - Cast-in-Place Concrete.

(3) Provide a 3-in. minimum depth of concrete between reinforcement and pipe or hanger components, and a 3-in. minimum depth covering on reinforcement.

4. End Connections:

a. Threaded Joint:

1) Pipe ends shall be reamed after pipe is cut to final length.

2) Threads shall be cleanly cut to the dimensions of the American Standard for Pipe Threads, ASME B1.1.

3) All burrs, dirt and foreign matter shall be removed and an application of pipe compound given to the threads of both pipe and fittings before assembly.

4) Apply a manufacturer’s recommended joint compound prior to installation. Apply joint compound to male threads only.

5) Compound shall be eliminated at the inside of the joint.

6) Once a joint has been tightened, it shall not be backed off unless all threads are re-cleaned and new compound applied.

b. Flanged Connections:

1) All flange faces shall be in perfect alignment with the holes straddling the vertical center line of the piping.

2) Properly center the gasket. Use full-face gaskets for flat-face flanges.

3) Gaskets shall be suitable for the service conditions referenced in Section 40 06 01 - Schedule for and Exposed Piping.

4) The gasket thickness shall be as recommended by the pipe manufacturer, with the exception that:

5) The minimum gasket thickness for raised face flanges shall be ⅛-in.

6) Bolts shall be of sufficient length so that when fully tightened, a minimum of two full threads shall extend beyond the nut.

7) Bolts shall be well lubricated over the entire thread length with a heavy graphite and oil mixture prior to the tightening operation.

8) Bolts shall be tightened with proper wrenches, care being taken to secure uniform pressure on the bolts and gasket and to avoid over stressing of the bolts, dishing of the flanges and compression of the gasket beyond its proper limits.

   a) Commercial grade carbon steel bolts, ASTM A307, Grade B shall be tightened to obtain approximately 15,000 psi stress based on the root area of the thread.

   b) Alloy steel bolts, ASTM A193, Grade B7 shall be tightened to obtain a stress of 45,000 psi.

   c) The pattern for tightening bolts shall be as per the manufacturer's recommendations.

c. Welded Joints:

1) All welding of the following shall be in strict conformity with the Code for Pressure Piping, ASME B31.1, Section 6.

2) Welding shall not be done when the atmospheric temperature is less than 32°F or when surfaces to be welded are wet.

3) The surface to be welded shall be free from loose scale, slag, rust, paint, oil and other foreign material. Joint surfaces shall be smooth, uniform and free from fins, tears and other defects which might affect proper welding.

4) Backing rings shall be used for all pipe welding butt joints unless otherwise specified.

   a) Backing rings shall be of carbon steel with spacer nubs that strike-off or melt with the weld.

5) Parts to be joined shall be approximately $^{1}/_{32}$-in. apart before tacking.

   a) Backing rings shall not be used at welded joints.

6) Piping shall be carefully aligned before welding and maintain alignment.

7) Small tack welds shall be made using a ⅛-in. electrode.

   a) Defective tack welds shall be removed before the final weld is made.

8) The first bead or layer of welding shall be laid by bridging across from bevel to bevel at the bottom of the groove just at the top of the land. A suitable crown reinforcement layer shall be made on the top of the joint to finish off.

   a) All layers of welding shall be of the same quality as the final welds and shall be fused thoroughly therein.

9) Direct current (dc) shall be used for welding, with the base material on the negative side.

10) Passes:

   a) The first pass shall be a stringer bead using a ⅛-in. electrode with a current of 80A to 90A at 50V to 55V.

   b) The second and succeeding passes shall be woven beads using a ⅛-in. electrode and a current of 90A to 100A at 55V to 58V.

   c) All passes shall be made slowly and with care not to burn through the land or the shoulder into the lining of the pipe.

   d) The joint shall not be hotter than 100°F.

   e) For large size pipe, a $^{5}/_{32}$-in. electrode may be used, provided the temperature of the joint is held within this limit.

   f) The surface of the finished welds shall have a bright metallic luster after cleaning, a fairly smooth and uniform contour with regular ripples and be free from overlaps, undercuts and excessive convexity.

11) No stress-relieving of welded joints is necessary unless the pipe wall thickness warrants it.

12) Welds shall be sound throughout, fused thoroughly and free from gas pockets, oxide, slag inclusions and surface porosity. The inside of the pipe shall be free from globules of weld metal, spacers or other material which would restrict the pipe area or become loose to enter the fluid stream.

13) Defective or unsound welds shall be corrected by removing and replacing the welds. Pipe or fittings which cannot be re-welded satisfactorily shall be replaced with new pipe or fittings at the Contractor's expense.

14) All welded joints will be visually inspected by the Engineer for defects beyond those acceptable in ANSI B31.1. Method of repair shall be in accordance with instructions as received from the Engineer.

C. Copper and Brass Pipe:

1. End Connections:

a. Soldered Joints:

1) Cleaning:

a) After cutting, all surfaces to be soldered shall be thoroughly cleaned to a metal-bright finish, free from dirt, grease or other material before fluxing and soldering.

b) This cleaning shall be performed by using emery cloth, sandpaper, or steel wool.

c) Clean the outside end of the tubing for a length of ½-in. greater than the depth of the fitting. The inside of the fittings shall be cleaned in a similar manner.

d) Apply non-corrosive flux to both the outside of the tubing and the inside of the fitting.

(1) Acid solder or acid flux will not be allowed.

2) Assembly:

a) Assemble the joint by inserting the end of tube into full depth of fitting socket.

3) Solder:

a) Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.

4) Joining:

a) The surfaces to be joined shall be heated up slowly and uniformly to the melting point of the solder.

(1) Heating torches of sufficient size shall be used for heating of large fittings prior to soldering.

(2) Multiple tips or ring burners for use on combination torches may also be used.

b) The surface being soldered shall be maintained above the melting point of the solder for sufficient time to draw the solder completely into the joint.

c) Form continuous solder bead around entire circumference of joint starting at the bottom.

d) When the solder congeals to a plastic state the excess metal shall be removed with a cloth brush, leaving a fillet around the end of the fitting.

e) Full penetration of the solder uniformly throughout the entire socket is required.

f) The soldered joints shall be allowed to cool in still air until only warm to the hand after which the work may be quenched.

5) Inspection of Joints:

a) Any type of crack, pinhole, area of incomplete penetration, or similar defect will not be accepted.

b) Peening for closing up defects shall not be permitted.

6) Cleaning:

a) Remove all external and internal loose solder and flux after joint cools.

b. Threaded Joints:

1) Use threaded joints for copper process piping any of the following locations:

a) When open flames for soldering are impractical

b) At unions and connections to equipment and appurtenances.

c) Where shown on the Contract Drawings

2) Flaring for Threaded Joints:

a) Cut the end of the copper tube square and ream to remove burrs.

b) Tubing to be flared shall be soft temper or annealed prior to flaring.

c) Tube that is out of round prior to flaring should be resized back to round..

d) Clean and polish contact surfaces of joints using an abrasive cloth.

e) Place flare nut over end of tube with threads closest to end being flared.

f) Insert appropriate length of copper tubing between flaring bar of flaring tool and position yolk with flaring cone over tube end and clamp yoke in place.

g) Ends of tubing shall be flared at an angle of 45°.

h) Turn the handle of the yolk clockwise without over-tightening.

(1) Use a flaring tool recommended by pipe manufacturer in accordance with the pipe manufacturer's instructions.

i) Pipe joint compound (nor any other material) shall be applied to the mating surfaces of the flare fitting and the flared tube end before attaching the flare nut to the fitting body.

3) Inspection of Flared Joints:

a) Cracked or deformed tubes will be rejected.

c. Unions:

1) Regardless of whether shown or indicated on the Contract Drawings, runs shall contain unions at all connections to valves and equipment, and at distances that permit convenient disassembly of piping and removal of equipment.

2. Pipe Flexibility

a. Make ample provisions for flexibility in all copper and brass pipelines.

D. PVC and CPVC Pipe Installation

1. End Connections:

a. Solvent-Welded Joints:

1) Make all solvent-welded PVC and CPVC joints in accordance with ASTM D2855 and the solvent manufacturer's approved instructions.

2) For PVC pipe, use primers and solvent cements meeting the requirements of ASTM F656 and ASTM D2564, respectively.

3) For CPVC pipe, use solvent cements meeting the requirements of ASTM F493.

4) Do not make solvent cement joints if temperature is below 40°F.

5) Do not make solvent cement welded joints in wet conditions.

6) The following procedure shall be followed to ensure proper gluing of PVC and CPVC pipe.

a) Ensure the end of the pipe is beveled.

b) Apply primer to the female end.

c) Apply primer to the male end.

d) Reapply primer to the female end; the primer must not dry.

e) Apply glue to the male end using an appropriately sized brush.

f) Apply glue with the brush to the female end.

g) Reapply glue to the male end.

h) Join the male and female ends with a quarter turn twist and hold for 30 sec.

7) After joint assembly, wipe excess cement from the pipe. A properly made joint will show a bead around the entire circumference. Any gaps in this bead indicate a defective joint, and the Contractor shall remake such joints at no additional cost to the City.

b. Threaded Joints:

1) Cut the end of the thermoplastic pipe square and smooth with a knife or a file.

2) Thread the pipe in accordance with the pipe manufacturer's recommendations. Brush threads clean.

3) After threading pipe, starting with second full thread, and continuing over the thread length, wrap 100% virgin Teflon thread tape in the direction of the thread. Overlap each wrap by one-half width of tape.

4) After application of the Teflon thread tape, screw fitting or coupling onto the pipe end to be joined. Hand tighten. Then

tighten the connection an additional one or two threads past the point of hand tightness.

3.03 FIELD TESTING / QUALITY CONTROL

A. Test all exposed piping in accordance with the requirements of Section 40 05 05.30 - Leakage Testing for Exposed Piping.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 05 06 – COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all couplings, adapters, and specials in pipelines, complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	16
2.04	Source Quality Control / Shop Tests	16
PART 3	EXECUTION	16
3.01	Examination / Preparation	16
3.02	Installation	16
3.03	Field Testing / Quality Control	17
3.04	Startup / Demonstration	17
3.05	Adjusting / Protection / Cleanup	17

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 10 – Quality Assurance Inspections

B. Section 09 91 00 – Painting.

C. Section 40 05 05 – Exposed Piping Installation.

D. Section 40 05 15 – Copper and Brass Process Pipe.

E. Section 40 05 19 – Ductile Iron Process Pipe.

F. Section 40 05 31 – Thermoplastic Process Pipe

G. Section 40 06 01 – Schedule for Exposed Piping

1.04 REFERENCES

A. Reference Standards:

1.	ASTM A47	Ferritic Malleable Iron Castings.
2.	ASTM A193/A193M	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
3.	ASTM A194/A194M	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
4.	ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes.
5.	ASTM A283/A283M	Low and Intermediate Tensile Strength Carbon Steel Plates.
6.	ASTM A513	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
7.	ASTM A536	Ductile Iron Castings.
8.	ASTM A635	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
9.	ASTM A744	Corrosion-Resistant Iron-Chromium-Nickel and Nickel-Base Alloy Castings for Severe Service.
10.	ASTM B26	Aluminum-Alloy Sand Castings.
11.	ASTM D2000	Classification System for Rubber Products in Automotive Applications.
12.	ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form).
13.	ASME B18.2.2	Fasteners in Customary Uses - Hex Nuts.
14.	ASME B31.1	Power Piping.
15.	AWWA	C606 Joints, Grooved and Shouldered Type.
16.	AWWA Manual M11	Steel Pipe - A Guide for Design and Installation.

1.05 DESCRIPTION

A. This Section includes requirements for providing couplings, adapters, and specials in accordance with applicable standards and regulations. In addition:

1. The scope of this Section shall include all buried and exposed process pipe.

2. The extent of process piping is shown on the Contract Drawings. Process pipe service, pipe diameter, pressure rating, joint type, and testing requirements are specified in the following section:

a. Section 40 06 01 — Schedule for Exposed Piping.

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturers:

1. The manufacturer(s) shall have a minimum of five (5) years of experience in the design and fabrication of coupling, adapter, and specials of similar size, capacity, and type to those shown on the Contract Drawings and specified in the Contract Documents, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

B. Supply and Compatibility:

1. Couplings, adapters, and specials shall be designed, fabricated, and installed in accordance with the latest standards referenced herein.

C. Regulatory Requirements:

1. Use only NSF61-approved materials in potable water lines.

2. Pipe couplings for making field joints between plain end, grooved end, and shouldered end pipe and fittings shall meet the requirements of ASME B31.1.

D. The following provisions shall pertain to Work under this Section:

1. Quality Assurance Inspections:

a. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved shop drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples, inspecting welds, verifying dimensions, coating and lining inspections.

b. Quality Assurance inspections shall be in accordance with Section 01 43 10 – Quality Assurance Inspections.

c. The Contractor shall give a minimum of two (2) weeks notice to the Engineer prior to the beginning of any fabrication, so that Quality Assurance inspection may be made.

d. Quality Assurance inspections shall include (but are not limited to) the following activities:

1) Review Certified Material Test Reports (both chemical and physical), Manufacturer's Certificates of Material Conformance, and Manufacturer's Certification.

2) ASTM A380 water wet and/or Ferroxyl test, as applicable.

3) Cleaning and passivating procedures, and operation, as applicable.

4) Perform visual inspection of in-progress and completed work.

5) Witness dimensional checks and shop fabrication.

6) Perform visual inspection and witness Liquid Penetrant Examination (PT) of welds.

7) Witness blasting, passivation and testing for iron contamination in accordance with ASTM A380.

8) Witness all testing as per ASME B31.1

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition:

1. Action Submittals:

a. The Contractor shall submit the following Shop Drawings and material specifications for the approval of the Engineer:

1) Location of couplings, adapters, and specials in pipeline.

2) Catalog data showing dimensions, materials, and component parts of each type of coupling, adapter, or special.

3) Harnessing and restraints where required.

4) Associated pipeline materials.

5) Working and test pressures.

6) Additional product data sufficient to demonstrate compliance with the Contract Documents.

2. Information Submittals:

a. Manufacturer instructions for handling, storing, installing, and adjusting of products.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver equipment and materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store equipment and materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sleeve type couplings shall be as manufactured by:

1. For steel pipelines:
    a. Type 411, as manufactured by Smith-Blair Co., Texarkana, AR.
    b. Or approved equal.
2. For ductile iron pipelines:
    a. ≤ 12-in.:
        1) Style 138, as manufactured by Dresser Manufacturing, a Division of Dresser Industries, Bradford, PA.
        2) 12" and smaller - Type 441, as manufactured by Smith-Blair Co., Texarkana, AR.
        3) Or approved equal.
    b. > 12-in.:
        1) Style 38, as manufactured by Dresser Manufacturing, a Division of Dresser Industries, Bradford, PA.
        2) Larger than 12" - Type 411, as manufactured by Smith-Blair Co., Texarkana, AR.
        3) Or approved equal.
3. For joining dissimilar piping materials:
    a. Style 162, as manufactured by Dresser Manufacturing, a Division of Dresser Industries, Bradford, PA.

b. Type 441, as manufactured by Smith-Blair Co., Texarkana, AR.

c. Or approved equal.

B. Groove and shoulder type couplings shall be as manufactured by:

1)

2. For ductile iron pipelines:

a. Groove Type Coupling:

1) Flexible Type:

a) Style 31, with flexible radius grooves, as manufactured by Victaulic Co., Easton, PA.

b) Or approved equal.

2) Rigid Type:

a) Style 31, with rigid radius grooves, as manufactured by Victaulic Co., Easton, PA.

b) Or approved equal.

b. Shoulder Type:

1) Style 31, as manufactured by Victaulic Co., Easton, PA.

2) Or approved equal.

3. For stainless steel pipelines:

a. Grooved Type Coupling:

1) Flexible type:

a) ¾-in. to 18-in.:

(1) Style 77S, as manufactured by Victaulic Co., Easton, PA

(2) Or approved equal.

2) Rigid Type:

a) 1 ½-in. through 12-in.:

(1) Style 489, as manufactured by Victaulic Co., Easton, PA

(2) Or approved equal.

b) 14-in. through 20-in.:

(1) Style W489, as manufactured by Victaulic Co., Easton, PA

(2) Or approved equal.

4. For copper pipelines:
    a. Grooved-type coupling:
        1) Rigid Type:
            a) Style 606, as manufactured by Victaulic Co., Easton, PA.
            b) Or approved equal.
5. For PVC/CPVC pipelines:
    a. Grooved Type Coupling:
        1) Flexible type:
            a) Style 177V, as manufactured by Victaulic Co., Easton, PA .
            b) Or approved equal.
        2) Rigid Type
            a) Style 357 Coupling, as manufactured by Victaulic Co., Easton, PA
            b) Or approved equal.
6. For High Density Polyethylene (HDPE) pipelines:
    a. Couplings for Plain End Piping:
        1) Rigid Type:
            a) 2-in. through 14-in.:
                (1) Style 905, as manufactured by Victaulic Co., Easton, PA.
                (2) Or approved equal.
            b) 16-in. through 36-in:
                (1) Style 908, as manufactured by Victaulic Co., Easton, PA
                (2) Or approved equal.

C. Groove and shoulder type full flow fittings shall be as manufactured by:
1. Victaulic Co., Easton, PA.
2. American Cast Iron Pipe Co., Birmingham, AL.
3. U.S. Pipe and Foundry Co., Bessemer, AL.
4. Or approved equal.

D. Bolted split sleeve type couplings shall be as manufactured by:

1. For steel pipelines:
    a. Restrained flexible couplings:
        1) Style 232 Bolted Split Sleeve, as manufactured by Victaulic Co., Easton, PA.
        2) Or approved equal.
    b. Non-restrained flexible couplings:
        1) 230/231 Bolted Split Sleeve, as manufactured by Victaulic Co., Easton, PA.
        2) Or approved equal.
2. For stainless steel pipelines:
    a. Restrained flexible couplings:
        1) Style 232S Bolted Split Sleeve, as manufactured by Victaulic Co., Easton, PA.
        2) Or approved equal.
    b. Non-restrained flexible couplings:
        1) 230S/231S Bolted Split Sleeve, as manufactured by Victaulic Co., Easton, PA.
        2) Or approved equal.

E. Thread Lubricant:
1. G-N paste (Molycote), as manufactured by Dow-Corning Industries, Auburn MI.
2. Or approved equal.

F. Dismantling Joints:
1. Model 975 as manufactured by Smith Blair
2. Model DJ400 as manufacturer by Romac Industries
3. Or approved equal.

G. Flexible Restrained Couplings
1. Model XTRA FLEX as manufactured by US Pipe
2. Or approved equal.

H. Tapping sleeves/saddles:
1. American Flow Control
2. Mueller Co.
3. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. General:

1. Coupling design and construction shall facilitate easy assembly in the field.
2. Flexible couplings shall be designed and constructed to insure permanently tight joints under all conditions of expansion, contraction, shifting and settlement to which the pipelines may be subjected as a result of the operation and layout of the process system in which they are installed.
3. Rigid couplings shall be designed and constructed to provide a tight joint and prevent pipe movement at the joint.

B. Couplings shall be either one of the following three types:

1. Sleeve Type:
   a. Sleeve type couplings shall be solid (axially un-split/unbolted) and have a middle ring or sleeve placed around the pipe joint.
   b. The middle ring shall be sealed by two wedge-shaped gaskets evenly compressed by follower flanges or rings tightened by bolts and nuts.
   c. The middle ring shall be coated on the interior and exterior with Ceramapure PL 90 ceramic/epoxy, as manufactured by Induron Coatings or an approved equal. The interior coating shall be 40 mils thick and exterior coating 20 mils thick.
2. Groove and Shoulder Type:
   a. Groove and shoulder type couplings shall have a C-shaped (cross section) sealing gasket placed around the joint.
   b. The gasket shall be enclosed in a split-type housing which shall engage shoulders or grooves in the pipe.
   c. The housing shall be assembled by bolts and nuts.
3. Bolted Split Sleeve Type.

C. Sleeve Type Couplings:

1. General:
   a. The maximum working pressure of the sleeve-type couplings shall not be less than:
      1) For pipe sizes ≤ 54 in.: 250 psig.
      2) For pipe sizes > 54 in. 200 psig.
2. For Ductile Iron and Steel Pipe Lines:
   a. Materials of Construction: steel.

b. The middle ring or sleeve and the follower rings or flanges shall be steel, ASTM A 283/A 283M (Grade A).

c. The middle ring or sleeve shall have flared or beveled ends.

d. The follower rings or flanges and the middle ring or sleeve shall be true circular sections free from irregularities, flat spots or surface defects.

e. The middle ring or sleeve shall not have a center pipe stop, unless otherwise specified, and shall have the minimum dimensions specified in Table 40 05 06-1.

TABLE 40 05 06-1
MINIMUM DIMENSIONS FOR SLEEVE TYPE COUPLING MIDDLE RING

Nominal Pipe Diameter: (in.)	**Middle Ring Thickness: (in.)**	**Middle Ring Length: (in.)**
≤ 8	1/2	5
10 - 30	1/2	7
> 30	½	10

f. After welding, welded steel follower rings shall be sized and tested by cold expanding a minimum of 1% beyond the yield point.

g. The middle ring shall be coated on the interior and exterior with Ceramapure PL 90 ceramic/epoxy, as manufactured by Induron Coatings or an approved equal. The interior coating shall be 40 mils thick and exterior coating 20 mils thick.

3. The middle ring thickness shall be the same as the associated pipe wall thickness. Gaskets:

a. Gaskets shall be resilient, wedge-shaped gaskets with a maximum angle of 40° at the wedge end.

b. Gasket material shall be compatible with the type and temperature of the fluid in the pipeline, and shall be the material recommended by the manufacturer for the service specified in Section 40 06 01 — Schedule for Exposed Piping.

D. Groove and Shoulder Type Couplings:

1. General:

a. Couplings shall be of the following types:

1) For steel pipe ≤ 24-in.: grooved type

b. Unless otherwise specified, groove-type couplings shall conform to the requirements of AWWA C606.

2. Materials and Construction:

a. Housing:

1) Housing shall be in two or more parts, closely fitting the pipe and gasket.

2) Housing material shall be ductile iron, ASTM A536 (Grade 654512), except for stainless steel and aluminum pipelines, which shall have housings of Type 316 stainless steel, ASTM A744 Grade CF-8M, and aluminum, ASTM B26, Alloy 356-T6, respectively.

b. Gaskets:

1) Gaskets shall be of materials compatible with the type and temperature of the fluid in the pipeline, and shall be of the material as recommended by the coupling manufacturer for the service specified in Section 40 06 01 — Schedule for Exposed Piping.

2) Gaskets shall be molded so that internal pressure tightens the seal. All gaskets shall be continuous, uniform in texture, and free from surface blemishes and defects.

E. Groove and Shoulder Type Fittings:

1. For steel and ductile iron pipe ≤ 24-in.:

a. Grooved end fittings shall be cast of ductile iron with working pressure ratings not less than shown in Table 40 05 06-2.

2. For steel and ductile iron pipe > 24-in.:

a. Fittings shall be provided with shoulders.

b. Working pressure ratings shall not be less than 150 psig.

c. Fabricated steel fittings shall be provided with extra-long end pieces to suit the coupling.

3. For stainless steel pipe:

a. Grooved end fittings shall be Type 304 matching the thickness or schedule of the stainless steel pipe shown in the pipe schedule Section 40 06 01 — Schedule for Exposed Piping.

TABLE 40 05 06-2
WORKING PRESSURE RATINGS FOR GROOVED END FITTINGS

Nominal Pipe Diameter: (in.)	Working Pressure: (psig)
¾ - 6	1,000
8 - 12	800
14 - 22	300
24	250

4. For Copper Pipe:
    a. Grooved end fittings shall be provided with rolled grooves and shall be designed for a working pressure not less than 300 psig.

F. Bolted Split-Sleeve Type Couplings:
1. General:
    a. Couplings for large diameter steel piping shall be bolted, split-sleeve type.
    b. Bolted split sleeve type couplings shall consist of four (4) basic components: two-piece housing, gasket assembly, bolts and nuts with restraining end rings as required for pipe restraint.
    c. The selected couplings shall be designed for the type, size and working pressure of the pipe with which they are to be used.
2. Materials and Construction:
    a. For stainless steel pipe: Coupling housing shall be manufactured from Type 316 stainless steel.
    b. For carbon steel pipe: Coupling housing shall be manufactured from carbon steel.
3. The split-sleeve coupling shall be constructed with a double arch cross section which closes around either:
    a. pipe section ends that have been smoothed for expansion or contraction, or
    b. pipe section ends with steel end rings affixed for restraining purposes.
4. The coupling shall confine an elastomeric gasket beneath the sleeve arches to create a radial seal as the coupling closes.

5. Elastomeric gasket materials shall have properties as designated by ASTM D2000 suitable for air service up to 240°F with intermittent exposure to 280°F.

6. Gasket sealing members shall consist of two O-ring gaskets and an elastomeric sealing pad bonded to an integral sealing plate. Internal pressure shall not be a requirement for fully completing the sealing function.

7. Restraining rings shall be furnished with the couplings and shall be of the same material as the coupling housing.

   a. Restraining rings for fixed type couplings shall be shop welded to the piping by the piping fabricator.

   b. The restraining rings shall be forwarded to the piping fabricator for shop mounting and welding in place.

   c. The coupling manufacturer's recommendation for size and amount of welding required for properly attaching the restraining rings shall be followed without exception.

8. When deflection is required at a pipe joint, a flexible coupling shall be provided.

   a. Minimum deflection for basic, lighter duty split sleeve (non-shouldered) design (e.g., Victaulic® Depend-O-Lok® Type 1) couplings shall be as specified in Table 40 05 06-3:

TABLE 40 05 06-3
MINIMUM DEFLECTION FOR BASIC, NON-SHOULDERED SPLIT SLEEVE COUPLINGS

Nominal Pipe Diameter: (in.)	**Minimum Deflection: (deg.)**
8 - 14	4.50
16-24	4.00
30 and 36	3.00
42 - 54	2.00
60	1.75
66 and 72	1.50
≥ 84	1.00

   b. Maximum deflection for heavier duty (shouldered) design (e.g., Victaulic® Depend-O-Lok® Type 2) couplings shall be as recommended by the manufacturer.

c. Coupling width shall not be less than 10-in. for pipe sizes 8-in. through 84-in., and not less than 12-in. for larger size pipe.

d. Minimum wall thickness of couplings shall be computed by the following formula:

$$t = \frac{P \cdot d}{2s}$$

Where: P = Design pressure in psig.
d = Pipe O.D. in in..
s = 18,000 psig design stress.

9. Bolts, nuts and miscellaneous hardware shall be furnished by the coupling manufacturer and shall be Type 316 stainless steel conforming to ASTM A276 and having a minimum tensile strength of 85,000 psig.

G. Bolts and Nuts:

1. Bolts:

a. Bolts shall be Type 316 stainless steel, ASTM A 193/A 193M, Grade B8, Class 2.

b. Bolts shall have American Screw Threads, Coarse Thread Series, ASME B1.1.

c. For all sleeve-type couplings, bolts shall be double radius head or buttonhead track type. The collars under the heads shall fit oval or square holes in the follower rings.

d. For all groove-and shoulder-type couplings, bolts shall be track type oval neck bolts. The collars under the heads shall engage the oval slots in the housing.

2. Nuts:

a. Nuts shall be Type 316 stainless steel conforming to ASTM A194/A194M.

b. Nuts shall be American Standard Heavy Dimension Series, ASME B18.2.2.

H. All flexible couplings shall be harnessed.

I. Wall Pipes:

1. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings.

2. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping.

3. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

4. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
4” – 12”	OD + 3.10”	0.50”
14” – 24”	OD + 4.15”	0.75”
30” – 36”	OD + 4.50”	1.00”
42” – 48”	OD + 5.00”	1.25”

J. Dismantling Joints

1. Dismantling joints shall be furnished at locations shown on the Drawings.

2. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.

3. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

4. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer’s recommendations.

5. Dismantling joints shall be provided with manufacturer’s fusion bonded epoxy painting system.

K. Flexible Restrained Couplings

1. Flexible restrained couplings shall be furnished at locations shown on the Drawings.

2. Flexible restrained couplings shall have pipe deflection and offset capabilities due to soil settlement.

3. Flexible restrained couplings shall be of ductile iron conforming to AWWA C110 and shall be rated for the same pressure as the connected piping.

4. For pipe size $\leq$ 24, the minimum allowable deflection angle shall be 8 degrees.

L. Quick Connect Couplings:

1. Type: Dual cam and groove, male end dimensionally meeting the requirements of A-A-59326D, with dust cap, Type 304 stainless steel chain and lock.
2. Body: Cast iron.
3. Cam Arms: Type 304 stainless steel.
4. Gaskets: Acrylonitrile butadiene synthetic rubber

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Refer to Section 09 91 00 – Painting.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The Contractor shall not install damaged items until repairs are made in accordance with manufacturer's written instructions and approval by Engineer.
    a. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement.

B. Preparation:

1. Ends of pipe, fittings and couplings shall be cleaned of all scale, dirt and thick outside coatings.
2. Before assembly, the ends of pipe and/or fittings and the outside of the coupling gasket shall be lubricated as recommended by the manufacturer.
3. Fasteners shall be assembled using a thread lubricant.

3.02 INSTALLATION

A. Install couplings, adapters, and specials for process piping in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Couplings shall be assembled by tightening diametrically opposite bolts evenly and progressively.
    a. Bolts on sleeve-type couplings shall not be tightened beyond the point of stretching (when the mill scale on the shank begins flaking off).

b. Bolts on groove- and shoulder-type couplings shall be tightened only until there is metal to metal contact between housing segments and the pipe.

B. Field Assembly of Groove-type Couplings:

1. Field grooving of pipe shall not be done unless approved by the Engineer, and then shall be limited to steel pipe 24-in. or under nominal diameter and to ductile and cast iron pipe 12-in. or under nominal diameter.

2. Field grooving shall be done only with special tools provided by the coupling manufacturer.

C. Harness for Sleeve-type Couplings:

1. In all pipelines under pressure, and elsewhere where shown, specified or required, sleeve-type couplings shall be harnessed.

a. On all pressurized ductile iron pipe, couplings shall be harnessed with stainless steel tie bolts and nuts connected to flanges or fittings installed on the pipe on each side of the coupling as shown, specified or required for the pipe sizes and specified test pressures.

1) The harnessed length from flange to flange shall not exceed 3 ft.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 05 07 – HANGERS AND SUPPORTS FOR PROCESS PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all hangers, supporting devices, and appurtenances shown, specified or required for pipes, fittings, valves, and other in-line equipment, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	14
2.04	Source Quality Control / Shop Tests	14
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Installation	14
3.03	Field Testing / Quality Control	18
3.04	Startup / Demonstration	18
3.05	Adjusting / Protection / Cleanup	18

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 10 - Quality Assurance Inspection

B. Section 03 30 00 – Cast-in-Place Concrete.

C. Section 03 60 00 – Grouting.

D. Section 05 05 13.10 – Galvanizing.

E. Section 05 50 00 – Metal Fabrications.

F. Section 09 91 00 – Painting.

1.04 REFERENCES

A. Reference Standards:

1.	ASTM A 36	Standard Specification for Carbon Structural Steel.
2.	ASTM A 48	Standard Specification for Gray Iron Castings.
3.	ASTM A 276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
4.	ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
5.	ASTM A778	Standard Specification for Welded, Un-annealed Austenitic Stainless Steel Tubular Products.
6.	ASME - B31.1	Power Piping.
7.	N.Y. Spec 32-P-6	Pipe, Special Castings, Valve Box Castings: Cast-Iron.
8.	MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture.
9.	MSS SP-59	Short Radius Welding Fittings.
10.	MSS SP-69	Pipe Hangers and Supports - Selection and Application.
11.	MSS SP-89	Pipe Hangers and Supports - Fabrication and Installation Practices.
12.	MSS SP-90	Guidelines on Terminology for Pipe Hangers and Supports.
13.	ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

14. Latest Edition of the New York City Building Code.

1.05 DESCRIPTION

A. This Section includes requirements for providing hangers and supports for process piping in accordance with applicable standards and regulations.

1. Included are rod hangers; clevis hangers, spring hangers; stanchion, roller and pipe pole supports and saddle stands; supports of structural steel; concrete saddles, concrete anchor blocks and bases, and all necessary

guides, restraints, fastening devices, anchor bolts, pipe anchors and appurtenances.

2. The Contractor shall provide all temporary pipe supports required during construction.

3. The Contractor shall provide hangers and supports of sufficient strength to maintain the pipelines and appurtenances in proper position and alignment under the maximum combination of peak loading conditions to include pipe weight, process fluid/gas weight, process fluid/gas movement and pressure forces, thermal expansion and contraction, vibrations, seismic forces, and all probable externally applied forces for all operating conditions.

4. The Contractor may retain the services of a pipe support designer for providing the design of all piping hangers and support systems in accordance with the requirements of this Section, unless otherwise shown or specified.

5. Stressors in hangers, rods and brackets shall be in accordance with Table 2 of MSS-SP-58.

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturer and Pipe Support Designer:

1. Pipe hangers, supports, and appurtenances shall be standard products of the manufacturer specified herein.

2. Each type of hanger and support shall be the product of a single manufacturer.

3. The pipe support designer, if retained by the Contractor, shall have a minimum of five (5) years of experience in the design of pipe supports and shall show evidence of having completed at least five (5) substantially similar, successful pipe support projects of equal complexity as the systems specified.

a. The pipe support designer shall be a New York State Registered Professional Engineer.

B. Supply and Compatibility:

1. All hangers and supports for process piping included in this section shall be provided by the Contractor through a single, qualified ductile iron process pipe manufacturer.

2. The pipe and fittings shall be designed, fabricated, and installed in accordance with standards referenced herein.

C. Regulatory Requirements:

1. All hangers and supports shall conform to the applicable requirements of ASME B31.1, MSS SP-58, SP-59, SP-69 and SP-90, except as modified

herein, and be of standard manufacture wherever possible, and best suited for the service required.

2. Unless otherwise approved, all hangers, supports and concrete inserts shall be listed with Underwriters' Laboratory, Inc.

D. Quality Assurance inspections may be made by NYC DEP Bureau of Engineering Design and Construction, Quality Assurance Section or its representative at the manufacturer's facility.

E. Quality Assurance Inspections shall be in accordance with the requirements of Section 01 43 10 - Quality Assurance Inspection.

F. The Contract shall give ample notice to the Engineer prior to the beginning of any fabrication, so that QA inspection may be made.

G. QA inspections shall include (but no be limited to) the following activities:

1. Obtain representative material samples of main components.

2. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.

3. Perform visual and dimensional inspection of completed work.

4. Testing of mechanical and chemical properties (sample(s) as required).

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Shop Drawings shall include, but not be limited to:

1) Detailed drawings showing all hangers and supports for each piping system. Drawings shall show:

a) Location, installation, material, loads, forces, stresses and deflections of all hangers and supports.

b) Reaction forces imparted to structures to which hangers and supports are attached shall be shown.

c) Contractor shall provide detailed drawings of each pipe support. Each drawing shall contain enough information to verify the pipe support design and to allow the manufacture of the device. At a minimum, the Contractor shall submit:

(1) Scaled details of the device with dimensions.

(2) A table of applied forces and moments.

(3) A complete bill of materials.

(4) An isometric showing the applied forces and moments.

(5) Detailed connections to existing structure.

(6) Shop and field welds.

2) Manufacturer's catalogs and engineering data on all hangers and supports.

3) Load ratings.

4) Materials.

5) Installation details.

b. Submit the name and qualifications of the support and hanger engineer.

c. All drawings and design calculations included in the shop drawings shall be signed and sealed by a New York State Registered Professional Engineer.

d. Pipe support design shall include detailed load and movement calculations:

1) In the design of hangers, supports and anchors, unless otherwise shown or specified, pipe pressures shall be the maximum test pressures specified for pipelines carrying gases and twice the maximum test pressures specified for pipelines carrying liquids.

2) The following loads shall be included in pipe support design and pipe stress analysis:

3) The gravity force, including the weight of the pipeline plus the weight of any appurtenances, contents, insulation, etc.

4) The thermal expansion force developed by the restraint of free end displacement of the piping.

5) Hydrostatic forces developed by internal pressure during operation of the piping system.

6) Loading due to expansion joint reaction forces.

7) Seismic forces, as required by the latest edition of the New York City Building Code.

8) Occasional load calculations and pipe stress analysis shall be provided where required by the Contract Documents, Building Codes, or Standards referenced herein. Occasional loads include:

a) Seismic forces.

b) Pressure waves produced by sudden changes in fluid momentum, commonly referred to as water hammer.

c) Wind, snow or ice loads.

d) Safety valve thrust loads.

e. Calculated forces shall be included in the pertinent shop drawings as called for by the submittal requirements specified herein.

2. Information Submittals:

a. When equipment or appurtenance manufacturers have indicated that piping loads shall not be transmitted to their equipment or appurtenance, certification that from said manufacturer(s) that the Contractor's hanger and support design complies with said manufacturer(s) requirements. Submit a separate certification for each equipment or appurtenance bearing piping loads supported, in whole or in part, by Contractor's hanger and support design.

B. Each submittal package for pipe hangers and supports shall have the stamp of a New York State Registered Professional Engineer experienced in pipe support design.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver equipment and materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Hanger inserts which are to be embedded in cast-in-place concrete shall be delivered in ample time not to delay the Work.

B. The Contractor shall store equipment and materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Hangers and supports shall be protected from condensation, corrosion, and deterioration.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. General:

1. The Contractor shall provide hangers and supports for all process piping and associated appurtenances, including, but not limited to valves, fittings, and specials, as follows:

   a. Where shown on the Contract Drawings: Provide hangers and supports as shown and as specified herein.

   b. Where not shown on the Contract Drawings: Provide hangers and supports in compliance with MSS SP-58 Table 2, and the requirements specified herein.

2. All hangers and supports shall allow minimum 3-in. of vertical adjustment.

B. Types:

1. Hangers for Single Pipes:

   a. Single pipes shall be supported by hangers suspended by rods from structural steel members, inserts in concrete ceilings and beams, bottom of trapeze hangers and wall mounted steel angle brackets. The strength of the rod shall be based on its root diameter.

   b. Except for piping subject to thermal expansion and contraction or as otherwise shown or specified, pipe hangers shall be adjustable clevis type MSS SP-58 Type-1.

   c. Piping subject to thermal expansion and contraction shall be supported on rollers.

2. Hangers or Supports for Multiple Pipes:

   a. Multiple pipes, running parallel in the same horizontal plane, and adjacent to each other, shall be suspended by trapeze type hangers or supported on wall brackets. Trapeze hangers shall consist of channel sections supported from threaded rods or attached to concrete walls, columns or structural steel support members.

   b. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets, shall be anchor or pipe chairs as required.

3. Supports for Single Pipe:

   a. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods specified herein or as shown on the Contract Drawings.

   b. Pipes shall be supported by adjustable stanchions, pipe saddle or roll supports with "U" bolts. Stanchions shall provide at least 4-inches adjustment and be flanged-mounted to floor.

   c. Stanchions and saddle stands shall be of Type 316L stainless steel.

   d. Pipe pole supports for pipe runs above ground, out-of-doors, and where otherwise required, shall consist of a suitable length of

stainless steel pipe set upright in at least four feet of concrete; two stainless steel angles secured to the top of the pipe, at right angle and on each side; a stainless steel plate welded to the top of the angles to serve as a horizontal support for the pipes. Supports shall be provided with attachments in the form of stands, clamps, rolls, rods or similar devices of the screw adjustable type in the vertical direction.

e. Where specified or shown, column supports of built-up welded stainless steel shall be provided, as approved by the Engineer.

f. Pipe rollers shall be cast ductile iron, unless otherwise shown or specified. Hardware and appurtenances shall be stainless steel.

4. Wall Supported Pipes:

a. Single or multiple pipes located adjacent to walls, columns or other structural members, and an excessive distance from ceilings or underside of beams, shall be supported using stainless steel wall brackets, MSS SP-58 Type 32 or 33.

b. Where pipes rest on top of bracket pipe supports, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs as required

5. Supports for Base Elbows:

a. Where pipes change direction from horizontal to vertical through a bend, a welded or cast base anchor support shall be installed at the bend to carry the load.

6. Supports for Vertical Pipes:

a. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs.

b. Riser clamps shall be MSS SP-58 Type 42 or 8.

c. Insulation shall be removed from insulated pipes prior to installing riser clamps.

7. Supports for Process Air Piping:

a. Air piping shall be supported on stainless steel saddle type supports in the locations shown on the Contract Drawings and as specified.

1) Fixed supports, as located on the Contract Drawings, shall hold the pipe firmly in place, preventing any movement.

2) Sliding supports, as located on the Contract Drawings, shall allow longitudinal movement of the pipe to account for thermal expansion.

3) Guides, as located on the Contract Drawings, shall allow for longitudinal pipe movement while preventing lateral movement and maintaining alignment.

b. Supports shall be fabricated Type 316L stainless steel.

1) Saddles shall support 120° of the pipe circumference and at least 12-in. along the length of the pipe.

2) Saddles shall be bolted to the structural steel or concrete slab supports.

3) Straps shall be of Type 316 stainless steel.

4) All sliding supports shall be provided with 8-in. wide hold-down straps.

5) Straps shall not clamp down on the pipe, but shall allow the pipe to slide on the saddle to permit thermal expansion.

c. All sliding supports shall have a resilient bearing pad of Teflon attached to the saddle to allow the pipe to slide on the saddle to permit thermal expansion.

d. All hangers from overhead supports shall be saddle or cradle-type hangers which shall support the lower 120° of pipe circumference and a minimum length equal to one quarter the pipe diameter, but not have less than 6-in. or more than 12 in..

1) Where pipe is supported from existing slabs, new through-slab hanger rods shall be used instead of expansion bolts, except where otherwise authorized by the Engineer.

8. Supports for Pipelines with Thermal Expansion:

a. Pipe rolls for single rod hangers: Stainless steel frame construction, ductile iron roller and stainless steel roller rod provided with threaded nuts; vertical adjustment permitted; for pipe sizes 6 in. or less unless otherwise approved.

b. Pipe rolls for double rod hangers: Ductile iron roller, stainless steel roller rod, malleable iron threaded sockets which permit vertical adjustment.

9. Supports for Pipelines Subject to Temperatures Greater than 300°F:

a. Spring hangers of heavy stainless steel construction.

10. Supports for Thermoplastic Pipes:

a. All thermoplastic pipe attachments shall have a continuous bearing cradle or saddle on the lower 120° of pipe circumference and a minimum length of one quarter pipe diameter, but not less than 6-in. nor more than 12-in..

11. Supports for Copper & Brass Pipes:

a. All copper and brass pipe supports shall be specifically manufactured for use with copper and brass pipe.

b. Hangers shall be provided with a copper finish.

12. Hangers for Radiators:

a. Support wall hung radiators on approved wall brackets or overhead hangers.

b. Support wall hung radiators by all-metal brackets and plates that are screw adjustable after erection.

1) Wall plates shall be made of stainless steel of size and shape to insure rigidity and strength and with a minimum resistance to expansion.

2) Plates shall be fastened directly to walls, columns or pilasters with at least one ½-in. bolt, and with spacing of brackets not in excess of 42-in..

c. Where rod hangers are specified or shown supporting wall radiators, supporting rods shall be not less than ⅝-in. in diameter.

13. Concrete Supports:

a. Where pipeline or mechanical equipment is shown, specified or required to be supported on concrete supports, supports shall be as specified herein.

b. Concrete supports for equipment shall be of a size and mass that will resist all forces, both static and dynamic, which may be developed by the equipment.

c. Concrete supports for pipe, fittings, valves and appurtenances shall be designed to carry the weight of the pipeline and appurtenances.

1) Cradles and anchor blocks shall safely withstand all stresses imposed by the pipelines, under all operating conditions.

2) Concrete cradles shall be shaped to fit the contour of the pipe.

d. Concrete supports shall be anchored to the floor of main structures by doweling or other approved means.

1) Anchor bolts, extension plates, saddle yokes and other hold-down devices in concrete bases shall be placed before pouring of concrete.

2) Expansion bolts shall not be used on new concrete supports except with the specific approval of the Engineer.

e. Concrete supports shall be not less than Class 25 as specified in Section 03 30 00, Cast-in-Place Concrete.

14. Protection Saddles for Insulated Pipe:
    a. Contractor shall furnish steel protection saddles on all supports for insulated pipe.
    b. For insulated pipes < 12-in. nominal diameter:
        1) Provide saddles of No. 14 U.S. gauge stainless steel curved 180° for use with roller hangers or structural trapeze hangers.
        2) Provide saddles of No. 16 U.S. gauge stainless steel curved 120° for use in clevis hangers.
        3) Saddles shall be at least 12-in. long.
        4) Saddle gripping side edges shall be turned up at least to the thickness of insulation.
    c. For insulated pipe ≥ 12-in. nominal diameter:
        1) Provide saddles of No. 12 U.S. gauge stainless steel with a welded centerplate to provide three-edge support.
        2) Saddles shall:
            a) Be at least as long as the pipe diameter.
            b) Provide 120 degree coverage.
            c) Have edge and centerplate depths equal to the insulation thickness.

C. Materials:
1. Hangers and supports shall conform to ASME B31.1.
2. Structural steel shall conform to ASTM A36 and ASTM A283.
3. Iron castings shall conform to ASTM A48 (Class No. 35).
4. Stainless steel shall conform to ASTM A 276:
    a. Use type 316 stainless steel for non-welded items.
    b. Use type 316L stainless steel for welded or fabricated items.
    c. Tensile Strength: 70,000 psi, minimum.
    d. Yield Strength: 25,000 psi minimum.
    e. Elongation in 2-in.: 35%.
    f. Reduction of area: 45%.
    g. For stainless steel pipe and tube: Use type 316L stainless steel conforming to the requirements of ASTM A778.
5. Rollers:
    a. Rollers, including stands and bases, shall be of cast iron, hot-dipped galvanized conforming to ASTM A123.

6. Expansion anchors for use in existing concrete structure:
   a. Material shall be Type 316 stainless steel.
7. Hanger Rods:
   a. Material shall be Type 316 stainless steel.
   b. Maximum allowable working stress shall be 5,800 psi, calculated based on the root diameter.
   c. Rods shall have a square head nut on top and running thread on bottom end.
8. Supports:
   a. Material shall be Type 316 stainless steel.
9. Appurtenances:
   a. Brackets, guides, restraints, rods, bolts, nuts and anchors shall be Type 316 stainless steel unless otherwise specified.
   b. Concrete inserts shall be of malleable iron with galvanized finish.

D. Sizing:
1. Size single and double rods based on the nominal pipe diameter in accordance with the Table 40 05 07-1.
   a. Hanger loads shall be calculated based on the weight of pipe filled with water plus 50 psf of dead load.

TABLE 40 05 07-1
MINIMUM PERMISSIBLE HANGER ROD DIAMETER FOR NOMINAL PIPE SIZES

Pipe Size (in.)	Single Rod (in.)	Double Rod (in.)	Max. Load per Hanger (lbs.)
¾ to 1½	⅜	⅜	300
2	⅜	⅜	325
2½	½	⅜	350
3	½	⅜	400
3½	½	⅜	450
4	⅝	½	850
5	⅝	½	950
6	¾	⅝	1,075
8	*⅞	⅝	1,350

Pipe Size (in.)	Single Rod (in.)	Double Rod (in.)	Max. Load per Hanger (lbs.)
10	*⅞	⅝	1,750
12	*⅞	¾	2,200
14	*1	⅞	2,500
16	*1	⅞	3,075
18	*1	⅞	3,700
20	*1¼	1	4,425
24	*1¼	1	6,050

* To be used subject to the Engineer's specific approval

E. Concrete Inserts, Attachment Plates, and Clamps:

1. Hanger Rods:

a. Hanger rods up to ⅞-in. diameter: Shall be attached to new concrete structures using concrete inserts of Type 18 in MSS SP-58.

1) Inserts shall be malleable iron with galvanized finish.

a) The use of steel inserts is prohibited.

2) Design of the inserts shall permit the rods to be adjusted laterally in one plane and to lock the rod nut or head to the body.

3) The inserts shall be provided with openings or recesses to receive reinforcing rods.

4) To facilitate installation, slots shall be provided in the exposed flanges of the insert.

5) Inserts shall be rated to safely carry the maximum load which can be supported by the hanger rod.

b. Hanger rods larger than ⅞-in. diameter: Shall be attached to new concrete by means of approved hook anchors as shown on the Contract Drawings.

c. All hanger rods shall be attached to existing concrete structures using stainless steel expansion anchors as specified in Section 05 50 00 - Metal Fabrications.

2. Steel beam clamps:

a. Shall be malleable iron.

b. For wide flange or I-beams: conform to MSS SP-58 Type 28 or Type 29.

c. For channel sections or where it is necessary to locate the hanger rod off the beam centerline: conform to MSS SP-58 Type 20.

3. Steel U-shape beam attachments welded to the underside of beams and welded steel brackets fastened to structural steel columns:

a. Shall be subject to specific approval of the Structural Steel and Pipe Supports Shop Drawings.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Galvanizing:

1. Conform to the requirements of Section 05 05 13.01 — Galvanizing, except as follows:

a. Malleable iron and concrete inserts shall be galvanized in conformance with the manufacturer's specifications.

B. Painting:

1. Conform to the requirements of Section 09 91 00 — Painting.

C. Surfaces Protection:

1. Surfaces of hangers and supports in contact with aluminum, brass, plastic and copper pipelines or pipeline equipment shall be protected with an approved plastic coating to prevent abrasion.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. The City may elect to conduct shop inspections. The inspections may include but not be limited to: mechanical and chemical testing, material sampling, material certifications, traceability of parts, blasting and painting, visual and dimensional inspection, and free iron contamination check on stainless steel parts.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The Contractor shall coordinate the Work such that all process piping hangers, supports, and restraining systems shall be installed and secured prior to the testing or activation of the process pipeline on which they are installed.

3.02 INSTALLATION

A. Design:

1. Types of hangers and supports shall be kept to a minimum.

2. Wherever possible, pipe supports shall be designed using manufacturer's standard catalog products.

3. Hangers and supports shall be located to prevent vibration or swaying and to provide for expansion and contraction.

4. Hanger and support units installation methods shall be in accordance with manufacturer's recommendations.

5. Hangers and Supports for piping systems subject to thermal expansion and contraction, or to similar movements imposed by other sources, shall be designed to provide flexibility, and pipe stress analysis shall be provided.

   a. Hangers and supports shall provide for expansion and contraction throughout the full operating temperature range.

6. Where resonance with imposed vibration and/or shock occurs during operation, suitable dampeners, restraints, anchors, etc., shall be added to remove those effects.

7. Hangers' rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.

8. Contact between dissimilar metals shall be prevented by use of copper plated, rubber or vinyl coated hangers or supports.

B. Hangers and Supports Embedded in Concrete:

1. Concrete embedded items shall be installed before concrete placement.

2. Embedded items shall be fastened securely to prevent movement during concrete placement.

3. Hangers and supports shall be adjusted and grout placed as specified in Section 03 60 00 — Grouting, to bring pipelines to specified elevations.

C. Supports and Hangers for Horizontal Pipes:

1. Supports and hangers for all piping shall be placed no farther apart than shown below, unless otherwise shown or specified:

   a. For ductile iron, steel, and stainless steel pipe:

      1) Maximum spacing in accordance with Table 3 of MSS-SP-69. The designer should check the capacity of the steel or building structure to which the hanger or support is attached, and adjust the maximum spacing accordingly.

      2) In addition, ductile iron pipe shall have a minimum of two supports per length and shall have a hanger or support adjacent to each end.

   b. For thermoplastic pipe, based on the following nominal pipe diameters:

      1) ≤ 1-in. dia.: 2 ft-6 in. center to center.

      2) 1½-in. to 3-in. dia.: 4 ft-0 in. center to center.

      3) 4-in. to 8-in. dia.: 6 ft-0 in. center to center.

4) > 8-in. dia.: 8 ft-0 in. center to center.

c. Tubing less than 1-inch diameter: In accordance with best piping practice and ASME B31.1, and as approved by the Engineer.

2. Hangers, supports, and accessories shall be located within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

3. Where hanger or support spacing does not correspond with joist or rib spacing, structural steel channels shall be attached to joists or ribs, and the pipes suspended therefrom.

D. Supports for Vertical Piping:

1. Spacing:

a. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration. Maximum spacing shall not exceed 25 ft.

2. Riser Clamps:

a. Riser clamp shall be placed under hub, fitting or coupling with approved solid bearing on steel sleeve.

b. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.

3. Base elbows or welded equivalent shall be provided at vertical piping bases.

4. Top support shall have a horizontal connection, and provide for pipe expansion.

E. Pipelines installed under plumbing work shall be spaced in conformity with the requirements of the New York City Building Code or as specified herein.

F. Additional Supports:

1. In addition to any and all requirements for the placement of supports specified herein, the Contractor shall provide additional supports as follows:

a. Additional supports shall be placed immediately adjacent to any change in piping direction, at equipment, and on both sides of valves, expansion joints and couplings.

b. Suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub or flanged end.

c. Except where otherwise shown or required, horizontally valves 6-inches and larger shall be supported on each side of the valve, by pipe hangers or supports.

d. At all flexible couplings, supports shall be placed on each side and as close to the coupling as possible. Supports shall be the guide type

which prevent axial movement from resulting in pipe deflection and misalignment.

e. Supports, anchorage and guidance for grooved end pipe shall be in accordance with the applicable sections of these specifications and the recommendations of the manufacturer.

G. Anchors and Sway Braces:

1. Anchors and sway braces shall be provided when required to hold the pipelines and equipment in position or alignment. Pipe anchors and braces for rigid fastening to the structures shall be attached to stainless steel anchor plates and anchor bolts set into the forms when placing concrete of new structures. Brackets and braces shall be attached to existing concrete structures with through bolts or expansion anchors.

2. Anchors, guides and restraints shall be provided for the proper operation of pipeline expansion joints.

3. Cast iron anchors shall be provided with stainless steel straps on piping, except where anchors form an integral part of pipe fittings and couplings or where an anchor of special design is required or shown on the Contract Drawings.

4. All pipe anchors, guides and restraints shall be designed to conform to ASME B31.1.

H. Expansion Joints and Flexible Couplings:

1. Supports, guides and anchors for flexible couplings and expansion joints shall be in accordance with the coupling and joint manufacturer's specification and the standards of the Expansion Joints Manufacturers Association.

I. Protection Saddles for Insulated Pipe:

1. Before placing the saddles, saddles shall be filled with either insulating cement or high density insulation cut to fit. For vapor barrier insulation, the barrier must be maintained; contact between hanger and support and bare pipe will not be permitted.

J. Adjustability:

1. Hangers and supports shall be capable of adjustment after placement of piping.

2. All points of adjustment for pipe and duct hanger rods shall be locked securely in place using double-nutting. Double-nutting means two nuts torqued directly against each other under each point of adjustment in addition to a third nut on top of the bracket. Damaging threads or tack welding as a method of locking adjustment is not permitted.

3. All threaded assemblies shall be double nutted or provided with pinned nuts. Alternately, tack welding of bolted assemblies may be acceptable unless provisions for vertical adjustment is required.

K. Any required pipe supports, for which the supports called for in this Section are not applicable, shall be fabricated or constructed from standard stainless steel shapes, concrete and anchor hardware, and shall be subject to the approval of Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Each pipe support system shall be tested in conjunction with the respective piping pressure tests.

1. Tests shall include cycling the piping system to duplicate operating conditions.

2. If any part of the pipe support system proves to be defective or inadequate, as evidenced by vibration or excessive movement, it shall be repaired or augmented at no additional cost to the City.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Touch-up shall be provided in the field, as required. Coating touchup shall be applied in accordance with the manufacturer's recommendations, and shall be free from spots and brush marks, to the satisfaction of the Engineer.

END OF SECTION

SECTION 40 05 15 – COPPER AND BRASS PROCESS PIPE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all copper and brass process pipe for non-potable uses, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

C. Schedules:

1. Refer to the following Section(s) for additional information on the piping that is to be constructed using the pipe materials and methods specified herein:

   a. Section 33 06 01 - Schedule for Buried Piping.

   b. Section 40 06 01 - Schedule for Exposed Piping.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 33 01 10.60 – Disinfection of Piping..

B. Section 33 05 05 – Buried Piping Installation.

C. Section 33 06 01 – Schedule for Buried Piping.

D. Section 40 05 05 – Exposed Piping Installation.

E. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

F. Section 40 05 07 – Hangers and Supports for Process Piping

G. Section 40 06 01 – Schedule for Exposed Piping.

H.

1.04 REFERENCES

1.	ASTM B32	Standard Specification for Solder Metal
2.	ASTM B42	Standard Specification for Seamless Copper Pipe, Standard Sizes
3.	ASTM B43	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
4.	ASTM B61	Standard Specification for Steam or Valve Bronze Castings
5.	ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
6.	ASTM B88	Standard Specification for Seamless Copper Water Tube
7.	ASTM B251	Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
8.	ASTM B302	Standard Specification for Threadless Copper Pipe, Standard Sizes
9.	ASME B1.20.1	Pipe Threads, General Purpose, Inch
10.	ASME B16.15	Cast Copper Alloy Threaded Fittings: Classes 125 and 250
11.	ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
12.	ASME B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fitting
13.	ASME B16.24	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500 and 2500

A.

B. Standards of the EJMA

1.05 DESCRIPTION

A. This Section includes requirements for providing copper and brass process pipe and accessories in accordance with applicable standards and regulations. In addition:

1. The scope of this Section shall include all copper and brass process pipe, fittings, and specials for non-potable uses. The scope of this Section shall not include copper and brass process pipe, fittings, and specials for potable uses.

2. The extent of copper and brass process piping is shown on the Contract Drawings. Copper and brass process pipe service, pipe diameter, coating, lining, pressure rating, joint type, and testing requirements are specified in the following section(s):

a. Section 33 06 01 - Schedule for Buried Piping.

b. Section 40 06 01 - Schedule for Exposed Piping.

3. Copper and brass process pipe, fittings, appurtenances, and specials shall be furnished and installed complete with all necessary jointing materials, wall castings, wall sleeves, specials, adapters, and other appurtenances as shown on the Contract Drawings, as specified herein, and/or as necessary and required for a complete installation.

a. Couplings for copper process pipe shall be provided as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process piping.

b. Hangers and support for copper and brass iron process pipe shall be provided as specified in Section 40 05 07 - Hangers and Supports for Process Piping.

4. Where shown on the Contract Drawings, the Contractor shall provide all labor and materials for making connections between copper and brass process pipe and existing lines(s) installed under other contracts, including all specials required to connect copper and brass process pipe to pipe of dissimilar material(s).

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturer:

1. The manufacturer shall have a minimum of five (5) years of experience in the design and fabrication of copper and brass process pipe, fittings, appurtenances, and specials of similar size, capacity, and type to those shown on the Contract Drawings and specified in the Contract Documents, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

B. Supply and Compatibility:

1. All copper and brass process pipe, fittings, appurtenances, and specials included in this section shall be provided by the Contractor through a single, qualified copper and brass process pipe manufacturer.
2. The pipe and fittings shall be designed, fabricated, and installed in accordance with standards referenced herein.
3. The manufacturer shall verify compatibility between the copper and brass process pipe, fittings, appurtenances, specials, and other Work.

C. Regulatory Requirements:

1. Copper and brass process pipe and fittings shall conform to the New York City Building Code in respect to plumbing and other applications covered by these laws.

1.07 SUBMITTALS

A. Submittals for all copper and brass process pipe shall comply with the requirements of Section 33 05 05 — Buried Piping Installation, and Section 40 05 05 — Exposed Piping Installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Brass process pipe and fittings shall be as manufactured by:

1. Metalloy Industries, Inc., Alachua, FL.
2. Or approved equal.

B. Copper process pipe and fittings:

1. Copper process pipe shall be as manufactured by:
   a. Mueller Industries, Inc., Memphis, TN.
   b. Or approved equal.

2. Copper process fittings shall be as manufactured by:
    a. NIBCO, Inc., Elkhart, IN.
    b. Or approved equal.
3. Flared Tube Fittings shall be as manufactured by:
    a. Mueller Industries, Inc., Memphis, TN.
    b. Or approved equal.
4. Triple-Lok Style Fittings shall be as manufactured by:
    a. Triple-Lok Fittings as manufactured by Parker Hannifin Corp., Cleveland, OH.
    b. Or approved equal.

C. Threadless copper process pipe and fittings:
1. Threadless copper pipe shall be as manufactured by:
    a. Cambridge-Lee, formerly Reading Tube Corp., Reading, PA.
    b. Or approved equal.
2. Threadless copper fittings shall be as manufactured by:
    a. Flagg-Flow Bronze Fittings as manufactured by Flagg Brass, Anniston, AL:
    b. Cambridge-Lee, formerly Reading Tube Corp., Reading, PA.
    c. Or approved equal.

D. Wall sleeve annular seals shall be as manufactured by:
1. Link Seal®, as manufactured by Thunderline Corp., Stafford, TX.
2. MetraSeal, as manufactured by The Metraflex Corp., Chicago, IL.
3. The Pipe Seal, as manufactured by Flexicraft Industries, Chicago, IL.
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Brass Pipe and Fittings:
1. Pipe:
    a. Provide red brass pipe that meets the requirements of ASTM B43.
    b. Provide pipe sizes, wall thicknesses and dimensions that meet the ASTM B251, B 43 Table 2 requirements for regular pipe.
    c. Nominal lengths of brass pipe shall be 12 ft.
    d. Each length shall be permanently marked by the manufacturer with name or trademark, type and conformity to standards.

e. Provide piping with a rough finish.

2. Fittings:

a. Provide brass pipe fittings that meet the requirements of ASME B16.15.

b. Provide brass fittings rated for steam working pressures up to 125 psig.

c. Provide brass fittings with a rough finish.

d. On all brass pipelines 3-in. nominal diameter or smaller, provide fittings conforming to ASTM B62, of 85-5-5-5 leaded red brass.

e. On all brass pipelines 4-in. nominal diameter or larger, provide bronze flanged fittings and pipe with screwed-on companion flanges rated for steam working pressures up to 150 psig.

1) Design flanged fittings to conform to ASME B16.24, 150 lb. standards.

3. End Connections:

a. Threaded joints shall be clean cut and tapered with smooth threads meeting ASME B1.20.1 requirements.

4. Unions:

a. Provide screwed unions made entirely of bronze, semi-finished, with ground joints.

B. Copper Pipe and Fittings:

1. Copper piping 3-in. nominal diameter and smaller:

a. Piping:

1) Provide Type K seamless, round, hard drawn copper tubing that meets ASTM B88 requirements.

2) Provide tube sizes, dimensions and wall thickness conforming to ASTM B88, Table 1 for Type K tubing.

3) Provide nominal lengths of hard copper tubing in straight lengths of approximately 20 ft, unless otherwise specified.

b. Fittings:

1) For copper tubing, use solder joint or flared end type fittings, as specified in Section 40 06 01 — Schedule for Exposed Piping.

2) No bending of hard copper tubing will be permitted, unless otherwise specified; make all bends and connections with suitable fittings.

3) Solder Joint Fittings:

a) Provide ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and copper alloy fittings.

b) Brazing alloy shall be copper-phosphorus alloy, Class BCuP-5, as specified by American Welding Society Spec. AWS A5.8.

4) Flared Tube Fittings:

a) Provide flared tube fittings meeting the requirements of the SAE Hydraulic Tube Fittings standard.

b) Flared fittings shall be of brass half-hard bar stock, ASTM B 16 (SAE 72) or of brass forgings, ASTM B 124, Alloy Number 2 (SAE 88).

c. End Connections:

1) Use threaded or soldered joints as specified in Section 40 06 01. Soldered joints shall use ASTM B32 lead-free solder.

2. Copper piping larger than 3-in. nominal diameter:

a. Piping:

1) Provide regular seamless copper pipe that meets the ASTM B42 requirements.

b. Fittings:

1) Provide solder type fittings of the same material as the pipe.

c. End Connections:

1) Use threaded or brazed joints as specified in Section 40 06 01.

C. Threadless Copper Pipe and Fittings:

1. Piping:

a. Provide hard drawn threadless copper pipe, standard pipe size pipe, conforming to ASTM B302 furnished in 20-foot lengths.

b. Limit maximum internal working pressure to 200 psig as computed using the Code for Pressure Piping, ASME B31.1.

2. Fittings:

a. Provide threadless bronze fittings with physical requirements meeting the following:

1) For lines 2-in. nominal diameter and smaller: ASTM B62.

2) For lines over 2-in. nominal diameter: ASTM B61.

3. Assemble threadless copper pipe ("TP") with threadless bronze fittings brazed together with the copper-silver-phosphorus type of brazing alloy to form a uniform, tight joint.

    a. The alloy shall be Class BCuP-5, in accordance with American Welding Society Spec. AWS A5.8.

4. Follow the brazing procedure specifications of the Copper and Brass Research Association (CABRA).

D. Expansion and Swing Joints:

1. General:

    a. When expansion joints are shown, specified or required, they shall be of the packless bellows type.

        1) For axial movements less than 4-in., expansion joints shall be of the internally pressurized design.

            a) Internally pressurized design bellows shall be suitable for a minimum of 5000 full pressure/temperature cycles at operating conditions.

        2) For axial movements 4-in. and greater., expansion joints shall be of the externally pressurized design.

            a) Externally pressurized design bellows shall be suitable for a minimum of 1000 full pressure/temperature cycles at operating conditions, and

    b. Bellows shall be designed in accordance with ASME Code, Section VIII, Appendix 26 or ASME B31.1.

    c. Swing or swivel joints:

        1) On brass and copper pipelines 2 in. nominal diameter or less that are rated at water working pressures less than 150 psig, all brass or bronze screwed end swing or swivel joints may be used, or the joints may be made up with nipples and fittings.

2. Materials and Construction:

    a. Bellows shall be of 18-8 stainless steel, of uniform curvilinear shape without circumferential welds and with not more than one longitudinal weld for each 10-in. of pipe diameter.

    b. Welds shall approximate the parent metal thickness without grinding, and metal thickness shall not be reduced by more than eight percent during forming.

    c. Expansion joints of the externally pressurized design shall have an internal carbon steel liner to prevent flow induced vibration and

internal and external guides welded to the inner end of pipe and outer cover to guide bellows movement.

d. A carbon steel external cover designed for full line pressure and a liquid drain shall be provided.

e. For risers in new concrete structures, an allowance of 0.2-in. per floor shall be made to accommodate frame shortening.

3. End Connections:

a. When connections are to be made to flanged pipe, expansion joints shall have flanged ends.

1) An approved dielectric insulating device shall be provided to separate carbon steel flanges from the flanges on brass pipe.

b. If connections are to be made to copper pipe or brass pipe with screwed joints, the expansion joints shall have flanged or weld end, and adapter fittings and dielectric insulating devices shall be provided.

E. Sleeves and Wall Castings:

1. Unless otherwise shown or specified, furnish and install suitable pipe sleeves at all points where pipes pass through walls or floors of structures.

2. Sleeve material shall be ductile iron or steel as shown on the Contract Drawings or as specified herein.

a. Ductile-iron sleeves shall conform to the requirements of Section 40 05 19 - Ductile Iron Process Pipe.

b. Steel sleeves shall conform to the requirements of Section 40 05 19 - Ductile Iron Process Pipe.

F. Wall Sleeve Annular Seals:

1. For penetrations through walls, partitions, or floors where fire-rated construction is not required:

a. Provide modular mechanical type seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall sleeve.

b. Provide an elastomeric element that is of the size, quantity, type and material that the manufacturer recommends for the intended service and that will provide an effective hydrostatic seal.

c. Bolts and nuts shall be stainless steel.

2. For all penetrations through fire-rated walls, partitions and floors:

a. Provide a permanent fire stop system.

b. The fire stop system shall maintain the integrity of the wall or floor system for the rated time period and shall allow normal pipe movement without being displaced.

c. The fire stop system shall be intumescent when exposed to flame or heat.

d. Asbestos shall not be used as fire stop material.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Brass Pipe and Fittings:

1. Fittings:

a. Screwed-on companion flanges:

1) For piping, use screwed-on companion flanges, shop assembled and faced true and at right angles to the pipe center line – field assembly of flanges and pipe shall not be permitted.

2) Use heavy machinery to screw on companion flanges until the end of the pipe projects beyond the face of the flange and a tight metal to metal joint is produced without evidence of heat in the threaded portion.

3) Cut off the projecting end of the pipe flush with the flange face and take a light refacing cut across both the end of the pipe and the face of the flange at right angles to the pipe center line.

4) Ream the pipe end to remove burrs and chips leaving a smooth interior surface.

B. Copper Pipe and Fittings:

1. For copper piping 3-in. nominal diameter and smaller:

a. Solder Joint Fittings:

1) Where brazing is specified, braze solder joint fittings and tubing in conformity to the specifications of Section 3 of the CABRA Copper Tube Handbook.

b. Flared Tube Fittings:

1) After flaring, anneal the joints before assembly.

2) Assemble couplings and fittings to prevent overstressing the tubing. Where required, use anti-seize lubricating compound to prevent galling and to facilitate assembly.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Damaged pipe will be rejected and shall be replaced at the Contractor's expense.

3.02 INSTALLATION

A. Install copper and brass process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.
2. Section 40 05 05 - Exposed Piping Installation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Perform field testing and quality control of copper and brass process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.
2. Section 40 05 05 - Exposed Piping Installation.

3.04 STARTUP / DEMONSTRATION

A. All potable water pipe shall be disinfected before they are placed into service, as specified in Section 33 01 10.60 - Disinfection of Piping.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning:

1. During construction, all piping shall be thoroughly cleaned before placement and the lines kept free from foreign matter of whatever origin. The pipes shall be left thoroughly clean to the satisfaction of the Engineer.
2. Flush all process and potable water pipelines with clean water.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 05 19 – DUCTILE IRON PROCESS PIPE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all ductile iron process pipe completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	11
2.04	Source Quality Control / Shop Tests	15
PART 3	EXECUTION	15
3.01	Examination / Preparation	15
3.02	Installation	15
3.03	Field Testing / Quality Control	15
3.04	Startup / Demonstration	15
3.05	Adjusting / Protection / Cleanup	16

C. Schedules:

1. Refer to the following Section(s) for additional information on the piping that is to be constructed using the pipe materials and methods specified herein:

   a. Section 33 06 01 - Schedule for Buried Piping.

   b. Section 40 06 01 - Schedule for Exposed Piping.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 10 - Quality Assurance Inspection.

B. Section 09 91 00 – Painting.

C. Section 33 01 10.60 – Disinfection of Piping.

D. Section 33 05 05 – Buried Piping Installation.

E. Section 33 06 01 – Schedule for Buried Piping.

F. Section 40 05 05 – Exposed Piping Installation.

G. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

H. Section 40 05 07 – Hangers and Supports for Process Piping.

I. Section 40 06 01 – Schedule for Exposed Piping.

J.

1.04 REFERENCES

A. AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in., for Water and Other Liquids

B. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

C. AWWA C115 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

D. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast, for Water

E. AWWA C153 Ductile-Iron Compact Fittings, 3-in. through 24-in. and 54-in. through 64-in., for Water Service

F. AWWA C606 Grooved and Shouldered Joints

G. ASTM B98 Copper Silicon Alloy Rod, Bar and Shapes

H. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

I. ASTM D714 Standard Test Method for Evaluating Degree of Blistering of Paints

J. ASTM D5162 Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

K. ASTM E96 Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

L. ASTM G22 Antibacterial Test

M. ASTM G95 Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)

N. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

O. DIPRA Handbook of Ductile Iron Pipe

P. NY Spec 24-C-38 Caulking

Q. New York City Building Code

R. CEN-EN-598 Ductile iron pipes, fittings, accessories and their joints for sewerage applications – Requirements and test methods

1.05 DESCRIPTION

A. This Section includes requirements for providing ductile iron process pipe and accessories in accordance with applicable standards and regulations. In addition:

1. The scope of this Section shall include all ductile iron process pipe, fittings, and specials.

2. The extent of ductile iron process piping is shown on the Contract Drawings. Ductile iron process pipe service, pipe diameter, coating, lining, pressure rating, joint type, and testing requirements are specified in the following section(s):

a. Section 33 06 01 - Schedule for Buried Piping.

b. Section 40 06 01 - Schedule for Exposed Piping.

3. Ductile iron process pipe, fittings, appurtenances, and specials shall be furnished and installed complete with all necessary jointing materials, wall castings, wall sleeves, specials, adapters, and other appurtenances as shown on the Contract Drawings, as specified herein, and/or as necessary and required for a complete installation.

a. Couplings for ductile iron process pipe shall be provided as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process piping.

b. Hangers and support for ductile iron process pipe shall be provided as specified in Section 40 05 07 - Hangers and Supports for Process Piping.

4. Where shown on the Contract Drawings, the Contractor shall provide all labor and materials for making connections between ductile iron process pipe and existing lines(s) installed under other contracts, including all specials required to connect ductile iron process pipe to pipe of dissimilar material(s).

5. The scope of this Section shall include all painting, coating, lining, gaskets, harnesses, bolts, nuts, and other appurtenances and material required to provide and assemble the lines.

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturer:

1. The manufacturer shall have a minimum of five (5) years of experience in the design and fabrication of ductile iron process pipe, fittings,

appurtenances, and specials of similar size, capacity, and type to those shown on the Contract Drawings and specified in the Contract Documents, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

2. Linings and coatings:

   a. Lining and coating manufacturer shall have a minimum of five (5) years of experience in protecting pipelines exposed to the service conditions specified in the Contract documents, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

3. When linings and coatings are not applied by the manufacturer, the lining and coating Subcontractor shall have a minimum of five (5) years of experience in the application of the specified linings and coatings for the specified service, and shall show evidence of at least five (5) substantially similar installations.

B. Supply and Compatibility:

1. All ductile iron process pipe, fittings, appurtenances, and specials included in this Section shall be provided by the Contractor through a single, qualified ductile iron process pipe manufacturer.

2. The pipe and fittings shall be designed, fabricated, and installed in accordance with standards referenced herein.

3. The Contractor shall bear responsibility for the quality of all factory-applied linings and coatings, regardless of the location of application.

4. The Contractor shall verify compatibility between the ductile iron process pipe, fittings, appurtenances, specials, and other Work.

C. Regulatory Requirements:

1. Ductile iron process pipe shall conform to the American National Standards Institute (ANSI) and American Water Works Association (AWWA) Standards specified herein and recommendations as given in the Ductile Iron Pipe Research Association (DIPRA) “Handbook of Ductile Iron Pipe.”

2. Ductile iron pipe for City water shall conform to the rules and regulations of the Bureau of Water Supply; requirements contrary to such rules and regulations specified herein shall be disregarded.

D. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved shop drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples, inspecting welds, verifying dimensions, and coating/lining inspections.

E. Quality Assurance Inspections shall be in accordance with the requirements of Section 01 43 10 – Quality Assurance Inspection.

F. The Contract shall give two (2) weeks notice to the Engineer prior to the beginning of any fabrication, so that QA inspection may be made.

G. QA inspections shall include (but no be limited to) the following activities:

1. Obtain representative material samples of main components.
2. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.
3. Perform visual and dimensional inspection of completed work.
4. Testing of mechanical and chemical properties (sample(s) as required)
5. Witness surface preparation and coating and lining operations, paint peel tests, and holiday tests.

1.07 WITNESS ANY REQUIRED HYDROSTATIC TESTS.SUBMITTALS

A. Submittals for all ductile iron process pipe shall comply with the requirements of Section 33 05 05 – Buried Piping Installation, and Section 40 05 05 – Exposed Piping Installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Pipes shall be loaded on properly padded saddles not less than 6-in. in width so that they do not bear against each other.
2. The whole load shall be securely fastened together as well as to any vehicle to prevent movement in transit.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Special care in handling shall be exercised during delivery, storage and handling of pipe to avoid damage and setting up stresses. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
2. The Contractor shall maintain the circular shape of the pipe and prevent distortion. Each length of pipe shall be temporarily braced with an approved type of internal spider in each end of the pipe during erection.
3. Handling Coated Pipe:
   a. Coated pipe shall be protected at all times and handled with equipment designed to prevent damage to the coating, such as stout wide canvas slings and wide padded skids.
      1) The use of bare chains, cables, hooks, metal bars or narrow skids in contact with the coating will not be permitted.

b. All pipe handling and hauling equipment shall meet the approval of the Engineer before use.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ductile iron process pipe and fittings shall be as manufactured by the following:

1. American Cast Iron Pipe Co., Birmingham, AL;
2. McWane Inc., Birmingham, AL;
3. U.S. Pipe and Foundry Co., Birmingham, AL;
4. Or approved equal.

B. Ceramic Epoxy Lining:

1. Protecto 401, as manufactured by Induron Protective Coatings, Birmingham, AL.
2. Or approved equal.

C. Expansion Joints:

1. Series 500, as manufactured by Mercer Rubber Company, Hauppauge, NY;
2. Or approved equal.

D. Flanged Adapters:

1. McWane Inc., Birmingham, AL;
2. Smith-Blair, Inc., Texarkana, AR;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Pipe shall be in accordance with AWWA C151 for push-on and AWWA C115 for flanged pipe and shall be of grade 60-42-10 ductile iron. The above standards cover ductile iron pipe with nominal pipe sizes from 3-in. up to and including 64-in. in diameter. Working pressure for the pipe shall be as called for in these Standards.

B. Pipe:

1. All pipe, including flanged pipe, for sizes up to and including 12-in. shall have a wall thickness equal to Special Thickness Class 56 as specified in AWWA C151.

2. All pipe, including flanged pipe, for sizes over 12-in. and up to 54-in. shall have a wall thickness equal to Special Thickness Class 54 as specified in AWWA C151.

C. Fittings:

1. Fittings shall be ductile iron and shall be in accordance with AWWA C110. Any other fittings, not included in AWWA C110, shall conform in design and performance to the requirements of this Standard.

2. Blind, filler, companion and reducing flanges shall conform to ANSI/ASME B16.1.

3. Where compact fittings are shown or indicated, items shall be in accordance with AWWA C153.

D. Flanged Joints:

1. Threaded Flanges: Shall be solid, threaded, ductile-iron, flanges meeting the requirements of AWWA C115. Threaded flanges and pipe shall be assembled and faced by the pipe manufacturer; field or shop assembly will not be accepted. Threaded flanges shall be screwed on tight without overstressing the threads and, when properly assembled, shall be concentric with the pipe.

2. The dimensions of all flanges for pipe fittings and specials and the number and sizes of bolts, up to and including 54-in., shall be in accordance with ANSI B16.1, Class 125 standard flanges.

3. Flanges shall be tapped where tap or stud bolts are required.

4. Bolts: Bolts shall be in accordance with Appendix A of AWWA C115 and as follows: Flanged joints shall be made with bolts or stud-bolts with a nut on each end. Bolts, stud-bolts and nuts shall be ANSI heavy dimension, semi-finish, with square heads and cold-punched hexagonal nuts. For bolts 1¾-in. in diameter and larger, stud-bolts shall be used. Bolt size shall be American Standard for ANSI Class 125 flanges. Where flanged joints are in manholes or submerged in tanks, bolts, stud-bolts, and nuts shall be silicon bronze, ASTM B98, Alloy A, of dimensions and sizes equal to steel bolts, stud-bolts, and nuts specified in Appendix A of AWWA C115.

5. Gaskets: Flange gaskets shall be in accordance with Appendix A of AWWA C115. They shall be full-face gaskets for flanged joints on 12-in. diameter and smaller pipe and shall be of the ring type for flanged joints on larger pipe.

6. After each flanged joint has been made, all bolt heads and nuts, and all surfaces of the flanges not to be painted shall be given two coats of asphaltic coating meeting the requirements of AWWA C151.

E. Grooved-Type Joints:

1. Shall be in accordance with AWWA C606 and Section 40 05 06 - Couplings, Adapters, and Specials for Process piping.

2. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.

3. Where grooved couplings are used instead of flanged joints, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint.

F. Push-On Type Joints

1. Shall be in accordance with AWWA C111.

G. Expansion Joints:

1. Heavy Duty Rubber Expansion Joints shall be installed where shown on the Contract Drawings.

2. Each Expansion Joint shall be installed with minimum of two control rods and compression sleeves, and as shown on the Contract Drawings.

H. Mechanical Joints – Restraint System:

1. Mechanical joints shall be assembled in accordance with AWWA C600 where required or shown on the Contract Drawings. Joints shall be restrained or harnessed to withstand test and surge pressure.

I. Flanged Adaptors:

1. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

   a. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

   b. Provide all products intended for installation on ductile iron pipe designed for and limited to use on ductile iron pipes that comply with the requirements of ANSI/AWWA C151/A21.51 and have a Brinell Hardness or equivalent measurement value that does not exceed 230BHN. These requirements apply to the entire pipe wall profile at all restraining wedge engagement points and to the full penetration depth of each restraining wedge.

   c. Provide restraint devices Listed by Underwriters Laboratories (3-inch (75 mm) through 12 inch (300 mm) size) and Designed by Factory Mutual (4-inch (100 mm) through 12-inch (300 mm) size).

   d. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

2. Joint Deflection capability:

a. 3-inch through 8-inch: 5 degrees

b. 10-inch and 12-inch: 3 degrees

c. 14-inch and 16-inch: 2 degrees

d. 18-inch and 20-inch: 1.5 degrees

e. 20-inch, 42-inch and 48-inch: 1 degrees

f. 30-inch and 36-inch (750 mm and 900 mm): 3 degrees

3. Provide flange adaptor to maintain seal with and 0.6 inch (15 mm) gap between end of pipe and mating flange

4. Working Pressure Rating:

   a. 16-inch and Smaller: 350 psi (2413 kPa)

   b. 18-inch : 300 psi (2068 kPa)

   c. 20-inch : 250 psi (1724 kPa)

   d. 24-inch: 200 psi (1379 kPa)

   e. 30-inch through 48-inch: 150 psi (1034 kPa)

   f. Minimum safety factor: 2 to 1.

5. Materials:

   a. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.

   b. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.

   c. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.

   d. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

6. Provide coating for restraint devices consisting of the following:

   a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.

   b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

   c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.

   d. Coating system: MEGABOND™ by EBAA Iron, Inc.

7. Manufacturer:

   a. EBAA Iron MEGAFLANGE Series 2100

J. Harnesses:

1. Where shown, specified or required, harnesses for pipe with mechanical joints shall be provided.

2. For ductile-iron pipe and fittings with mechanical joints that require harnessing, restrained type mechanical joint pipe will be considered as an alternate upon submission to the Engineer for approval.

3. Joint Assemblies: Joint assemblies shall be designed to resist pullout of the joints at the test pressures specified for the piping system.

K. Sleeves:

1. Sleeves shall be in accordance with AWWA C110. They shall be of ductile iron and shall be provided at all points where pipes will pass through walls and floors and where wall or floor castings are not provided. Unless otherwise shown, sleeves shall have intermediate collars not less than ½-in. thick and 1½ to 2-in. high located at the center of the wall.

2. For exterior walls of structures, wall sleeves shall be plain ends and of flush wall design.

3. Where shown on the Contract Drawings, modular wall seals shall be installed in the annular space between the pipe and the sleeve. In all other locations, caulk shall be installed in the annular space between the pipe and the sleeve. Caulking materials shall be in accordance with N.Y. Spec 24-C-38. For flanged pipe, sleeves shall be fabricated large enough to accommodate flanges.

L. Sleeve-Type Couplings:

1. Sleeve-type couplings shall be in accordance with Section 40 05 06 – Couplings, Adapters, and Specials for Process piping

2. Pipe and fittings for use with sleeve-type flexible couplings shall be plain end.

3. Sleeve wall thickness shall be the same as the associated ductile iron process pipe wall thickness.

M. Wall Castings, Connecting Pieces, and Special Fittings:

1. Wall castings and connecting pieces shall be in accordance with AWWA C110, 250 psi pressure rating, unless specified otherwise. Concrete encased wall castings connected to valves shall be cast from alloy iron, Ni-Resist Type 1, International Nickel Co. or approved equal. Wall castings and connecting pieces shall be furnished with ANSI Class 125 flanged ends, bell ends, flare ends and/or spigot ends where shown, specified or required.

2. Wall castings shall be of standard wall pipe dimensions, unless piping layout precludes their use, in which case special castings shall be furnished.

3. Design of Specials: Special fittings where required shall be of an approved design that meet the same specifications and have the same diameters and thicknesses as standard fittings. Any tees, crosses, elbows, laterals, reducers or other fittings of current ANSI or AWWA standard dimensions are not considered specials.

4. Intermediate Collar: Wall castings shall have an integrally cast intermediate collar not less than ½-in. thick and 1½-in. to 2-in. high located at the center of the wall unless otherwise shown.

5. Where space limitations prevent the use of through bolts for assembling flange connections, stud bolts shall be provided on wall casting flanges.

N. Cleanouts:

1. Cleanouts shall be furnished and installed where shown or specified.

2. Size: Cleanout openings shall be not less than 6-in. diameter for pipe 8-in. in diameter or larger. For pipe 6-in. in diameter or smaller, they shall be of the same diameter as the pipe.

3. Cleanout Covers: Cleanout covers which are blind flanges shall be in accordance with AWWA C110, except where conformation is required with the inside curvature of the pipe, in which case the covers shall be flanged plugs of proper shape with American Standard flange drilling.

4. Covers shall be fastened by means of Type 316 stainless steel studs, washers, and nuts, and shall be drilled and tapped for a 1½-in. diameter pipe connection.

5. Flange plugs shall be equipped with a dowel or other suitable means to provide proper setting.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Coatings and Linings:

1. General:

a. Ductile iron process pipe shall be lined and coated in accordance with the piping schedule(s) included in the following Section(s):

1) Section 33 06 01 - Schedule for Buried Piping.

2) Section 40 06 01 - Schedule for Exposed Piping.

b. All bolts, nuts, couplings and the like shall be coated after the joint has been made.

c. Painting shall be in accordance with Section 09 91 00 - Painting.

d. Pipe and fittings that are to be encased in concrete shall not be painted.

2. Ceramic Epoxy Lining:

   a. Lining applicator:

      1) Lining shall be applied by a certified firm or manufacturer with a successful history of applying linings to the interior of ductile iron pipe and fittings.

      2) Manufacturer must be independently inspected at least two (2) times per year with certification stating compliance with the requirements specified herein.

   b. Lining materials: Amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment, and shall have:

      1) A permeability rating of 0.00 as per Method A of ASTM E 96, Procedure A (test duration of 30 days).

      2) Results equal to 0.0 undercutting after two years as per ASTM B 117.

      3) Results to equal no more than 0.5mm undercutting after 30 days as per ASTM G 95 cathodic disbondment 1.5 volts at 77°F.

      4) Immersion testing rated using ASTM D 714, with the following results after two years' duration testing of:

         a) 20% Sulfuric acid: No effect.

         b) 140°F 25% Sodium Hydroxide: No effect.

         c) 160°F Distilled Water: No effect.

         d) 120°F Tap Water (scribed panel): 0.0 undercutting with no effect.

      5) Results of only trace growth using ASTM G 22 at 30°C after 7 days.

      6) An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598, Section 7.8.

   c. Application:

      1) Condition of pipe prior to application: Prior to application of the ceramic epoxy lining:

         a) Interior: No other coating or lining shall have been applied to the entire interior of the pipe.

         b) Exterior: No other coating or lining shall have been applied to the first six inches of the exterior of the spigot ends.

      2) Surface preparation:

a) Inspect application area for oil, grease, etc. prior to abrasive blasting. Solvent clean if necessary or required for coating application.

b) Abrasive blast application area using sand or grit abrasive media to remove all rust, loose oxides, etc. Only slight stains and tightly adhering oxide shall remain on application surface. If rust reappears before application, or if more than 12 hours elapses before application, repeat blasting procedure specified herein.

3) Lining:

a) Pipe shall be lined within 12 hours of surface preparation.

b) Apply 40 mils nominal dry film thickness to interior of pipe.

c) Lining shall not take place when the substrate or ambient temperature is below 40°F.

d) Ensure surface is dry and dust free.

e) Do not apply lining to flange faces.

4) Coating of Bell Sockets and Spigot Ends

a) Apply joint compound as per Manufacturer's instructions to the gasket area and spigot end up to 6 in. back from the end of the spigot end.

b) Apply 6 mils nominal, 10 mils maximum even coverage.

c) Manufacturer's joint compound shall be applied by brush to ensure full and complete coverage.

d) Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends.

e) Coating of the gasket seat and spigot ends shall be done after the application of the lining.

5) Number of Coats

a) The number of coats of lining material applied shall be as recommended by the lining manufacturer.

b) In no case shall lining material be applied above the dry thickness per coat recommended by Manufacturer in printed literature.

c) The maximum or minimum time between coats shall be that time recommended by Manufacturer.

d) To prevent delamination between coats, no material shall be used for lining which is not indefinitely re-coatable with itself without roughening of the surface.

6) Touch-Up and Repair

a) Use Manufacturer's joint compound for touch-up or repair in accordance with Manufacturer instructions

d. Inspection:

1) All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge as per SSPC PA-2.

2) Test interior of all pipe and fittings for pinholes with a non-destructive 2500-volt test in accordance with ASTM D5162. Any defects found shall be repaired and re-inspected prior to shipment.

3) Certification: Submit certification from the pipe or fitting manufacturer attesting to the fact that the applicator met the requirements of this Specification, as well as the lining manufacturer's recommendations for preparation and application, and that the material used is as specified.

e. Mark each pipe joint and fitting with the date of application of the lining system along with its numerical sequence of application on that date. Numerical sequence shall correspond with records maintained by the applicator of the Work.

3. Exterior Primer:

a. Pipe and fittings shall be shop coated on the outside in accordance with Section 09 91 00 - Painting, for use in exposed locations, such as inside buildings where finish painting or insulating is required.

4. Painting:

a. Pipe and fittings shall be painted in accordance with the requirements of Section 09 91 00 - Painting.

5. Asphaltic Coating:

a. Pipe and fittings that will not be exposed to view shall be coated with the standard asphaltic outside coating specified in AWWA C151, at twice the specified thickness.

b. Unlined pipe shall be coated with the standard asphaltic inside coating specified in AWWA C151.

6. Epoxy and Urethane Coatings:

   a. Epoxy and urethane coatings shall be applied in accordance with Section 09 91 00 - Painting.

7. Concrete Encased Pipe:

   a. Pipe and fittings which are to be encased in concrete where water-tightness is to be obtained shall not be coated or painted on the outside.

8. Labels:

   a. In addition to the information required to be cast onto the pipe by AWWA C151, the letters "N.Y.C." shall be painted on the outside of each pipe, fitting, and special casting.

9. Pipe Couplings:

   a. Where flexible or rigid couplings are to be used, the exterior coating on the ends of pipe and fittings shall be left off for approximately 8-in., but the interiors shall be lined throughout.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Damaged pipe will be rejected and shall be replaced at the Contractor's expense.

3.02 INSTALLATION

A. Install ductile iron process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.

2. Section 40 05 05 - Exposed Piping Installation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Perform field testing and quality control of ductile iron process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.

2. Section 40 05 05 - Exposed Piping Installation.

3.04 STARTUP / DEMONSTRATION

A. All potable water pipe shall be disinfected before they are placed into service, as specified in Section 33 01 10.60 - Disinfection of Piping.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 05 31 – THERMOPLASTIC PROCESS PIPE
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all thermoplastic process pipe, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

C. Schedules:

1. Refer to the following Section(s) for additional information on the piping that is to be constructed using the pipe materials and methods specified herein:

   a. Section 33 06 01 - Schedule for Buried Piping.

   b. Section 40 06 01 - Schedule for Exposed Piping.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting.

B. Section 33 01 10.60 – Disinfection of Piping.

C. Section 33 05 05 – Buried Piping Installation.

D. Section 33 06 01 – Schedule for Buried Piping.

E. Section 40 05 05 – Exposed Piping Installation.

F. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

G. Section 40 05 07 – Hangers and Supports for Process Piping.

H. Section 40 06 01 – Schedule for Exposed Piping.

1.04 REFERENCES

A. Reference Standards:

1.	ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form).
2.	ASME B18.2.1	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lag Screws (Inch Series).
3.	ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
4.	ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
5.	ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40,80 and 120.
6.	ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
7.	ASTM D2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
8.	ASTM D2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
9.	ASTM F437	Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
10.	ASTM F439	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

11.	ASTM F441	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
12.	ASTM F442	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
13.	AWWA C207	Steel Pipe Flanges for Waterworks Service, Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).

1.05 DESCRIPTION

A. This Section includes requirements for providing thermoplastic process pipe and accessories in accordance with applicable standards and regulations. In addition:

1. The scope of this Section shall include all thermoplastic process pipe, fittings, and specials.

a. Thermoplastic process pipe includes:

1) PVC process pipe.

2) CPVC process pipe.

2. The extent of thermoplastic process piping is shown on the Contract Drawings. Thermoplastic process pipe service, pipe diameter, pressure rating, joint type, and testing requirements are specified in the following section(s):

a. Section 33 06 01 – Schedule for Buried Piping.

b. Section 40 06 01 – Schedule for Exposed Piping.

3. Thermoplastic process pipe, fittings, appurtenances, and specials shall be furnished and installed complete with all necessary jointing materials, wall castings, wall sleeves, specials, adapters, and other appurtenances as shown on the Contract Drawings, as specified herein, and/or as necessary and required for a complete installation.

a. Couplings for thermoplastic process pipe shall be provided as specified in Section 40 05 06 – Couplings, Adapters, and Specials for Process piping.

b. Hangers and support for thermoplastic process pipe shall be provided as specified in Section 40 05 07 – Hangers and Supports for Process Piping.

4. Where shown on the Contract Drawings, the Contractor shall provide all labor and materials for making connections between thermoplastic process pipe and existing lines(s) installed under other contracts, including all specials required to connect thermoplastic process pipe to pipe of dissimilar material(s).

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturer:

1. The manufacturer shall have a minimum of five (5) years of experience in the design and fabrication of thermoplastic process pipe, fittings, appurtenances, and specials of similar size, capacity, and type to those shown on the Contract Drawings and specified in the Contract Documents, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

B. Supply and Compatibility:

1. All thermoplastic process pipe, fittings, appurtenances, and specials included in this section shall be provided by the Contractor through a single, qualified thermoplastic process pipe manufacturer.

2. The pipe and fittings shall be designed, fabricated, and installed in accordance with the latest standards referenced herein.

3. The manufacturer shall verify compatibility between the thermoplastic process pipe, fittings, appurtenances, specials, and other Work.

C. Regulatory Requirements:

1. Thermoplastic pipe and fittings shall conform to the New York City Building Code in respect to plumbing and other applications covered by these laws.

2. Use only NSF61-approved materials in potable water lines.

1.07 SUBMITTALS

A. Submittals for all thermoplastic process pipe shall comply with the requirements of Section 33 05 05 – Buried Piping Installation, and Section 40 05 05 – Exposed Piping Installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. CPVC process pipe and fittings shall be as manufactured by:

1. B. F. Goodrich (now Lubrizol Advanced Materials, Inc.),
2. Lewis Pipe Company,
3. Or approved equal.

B. PVC and CPVC Solvent cement shall be as manufactured by:

1. Weld-On®, as manufactured by IPS Corp.,
2. Or approved equal.

C. Wall sleeve annular seals as manufactured by:

1. Link-Seal®, as manufactured by Thunderline Corp.,
2. MetraSeal, as manufactured by the Metraflex Corp.,
3. The Pipe Seal, as manufactured by Flexicraft Industries,
4. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Thermoplastic process pipe shall be as uniform as commercially practicable in color, capacity, density and other physical properties.
2. Nominal length of thermoplastic pipe shall be 20 ft,.

B. PVC Pipe and Fittings:

1. General:
   a. PVC pipe and fittings shall meet the requirements of ASTM D1785, Type I, Grade I.
   b. PVC pipe and fittings shall be Sch. 80, unless otherwise shown or specified.
2. Materials and Construction:
   a. PVC pipe and fittings shall be manufactured from PVC compounds meeting the requirements of ASTM D1784, Class 12454-B.
3. End Connections:
   a. Socket type fittings shall conform to ASTM D2467.
   b. Threaded fittings shall conform to ASTM D2464.

C. CPVC Pipe and Fittings:

1. General:

a. CPVC pipe and fittings shall meet the requirements of ASTM F441.

b. CPVC pipe and fittings shall be Sch. 80, unless otherwise shown or specified.

2. Materials and Construction:

a. CPVC pipe and fittings shall be manufactured from CPVC compounds meeting the requirements of ASTM D1784.

3. End Connections:

a. Socket-type fittings shall conform to ASTM F439.

b. Threaded fittings shall conform to ASTM F437.

D. SDR Series Pipe:

1. PVC SDR Series pipe shall meet the requirement of ASTM D2241.

2. CPVC SDR Series pipe shall meet the requirements for ASTM F442.

E. Steel Flanges:

1. Only where shown on the Contract Drawings and/or explicitly specified herein, steel pipe flanges, cadmium plated, complying with AWWA C207 shall be provided.

2. Bolts and stud bolts shall be of steel, ASTM A307, Grade B, cadmium plated. Bolts and stud bolts shall conform to the dimensional requirements of ASME B18.2.1 with rolled threads conforming to ASME B1.1, Coarse series, Class 2 fit.

a. Bolts and stud bolts and nuts shall be of American Standard heavy unfinished hexagonal type.

F. Sleeves:

1. Provide steel pipe sleeves at all points where pipes pass through walls or floors of structures as specified in Section 40 05 19 – Ductile Iron Process Pipe.

2. Provide steel sleeves of Schedule 40 minimum thickness, with waterstop.

G. Wall Sleeve Annular Seals:

1. For penetrations through walls, partitions, or floors where fire-rated construction is not required:

a. Provide modular mechanical type seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall sleeve.

b. Provide an elastomeric element that is of the size, quantity, type and material that the manufacturer recommends for the intended service and that will provide an effective hydrostatic seal.

c. Bolts and nuts shall be stainless steel.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Damaged pipe will be rejected and shall be replaced at the Contractor's expense.

3.02 INSTALLATION

A. Install thermoplastic process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.
2. Section 40 05 05 - Exposed Piping Installation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Perform field testing and quality control of thermoplastic process pipe, fittings, and specials in accordance with the requirements of the following Section(s):

1. Section 33 05 05 - Buried Piping Installation.
2. Section 40 05 05 - Exposed Piping Installation.

3.04 STARTUP / DEMONSTRATION

A. All potable water pipe shall be disinfected before they are placed into service, as specified in Section 33 01 10.60 – Disinfection of Piping.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning:

1. During construction, all piping shall be thoroughly cleaned before placement and the lines kept free from foreign matter of whatever origin. The pipes shall be left thoroughly clean to the satisfaction of the Engineer.
2. Flush all process and potable water piping with clean water.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 05 53 – PROCESS VALVES FOUR-INCH DIAMETER AND LARGER
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all process valves four-inch diameter and larger completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	4
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	6
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	34
2.04	Source Quality Control / Shop Tests	36
PART 3	EXECUTION	38
3.01	Examination / Preparation	38
3.02	Installation	38
3.03	Field Testing / Quality Control	39
3.04	Startup / Demonstration	39
3.05	Adjusting / Protection / Cleanup	39

C. The following schedule(s), attached after the End of Section designation, are a part of this Section:

1. Schedule 40 05 53-1 – Process Valves Four-inch Diameter and Larger.
2. Schedule 40 05 53-2, Table of Full Open Cv Values for Modulating High Performance Butterfly Valves.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.01 – Welding.

B. Section 09 91 00 – Painting.

C. Section 26 05 91 – Low-Voltage Electric Motors.

D. Section 33 06 01 – Schedule for Buried Piping.

E. Section 40 05 56- Process Valves, Smaller Than Four-Inch Diameter

F. Section 40 05 97 – Identification for Process Equipment.

G. Section 40 06 01 – Schedule for Exposed Piping.

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	NRS	Non Rising-Stem.
2.	OS&Y	Outside Screw and Yoke.
3.	FS	Federal Specification

B. Definitions:

1.	Non-ferrous metals:	All metal mixtures including copper, tin, zinc, lead, and/or other metals, in which iron does not predominate.

C. Reference Standards:

1.	ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.
2.	ASME B16.34	Valves-Flanged, Threaded, and Welding End.
3.	API 594	Check Valves: Flanged, Lug, Wafer and Butt-welding.
4.	API 598	Valve Inspection and Testing.
5.		
6.	ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
7.	ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
8.	ASTM A194	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
9.	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet,

		and Strip for Pressure Vessels and for General Applications.
10.	ASTM A276	Standard Specification for Stainless Steel Bars and Shapes.
11.	ASTM A351	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
12.	ASTM A380	Standard Specification for Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
13.	ASTM A536	Standard Specification for Ductile Iron Castings.
14.	ASTM A564	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
15.	ASTM A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
16.	ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings.
17.	ASTM B138	Standard Specification for Manganese Bronze Rod, Bar and Shapes.
18.	ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
19.	ASTM B265	Standard Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate.
20.	AWWA C500	Metal-Seated Gate Valves for Water Supply Service.
21.	AWWA C507	Ball Valves, 6 In. Through 60-in..
22.	AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. Through 24-in..
23.	AWWA C541	Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
24.	AWWA C542	Electric Motor Actuators for Valves and Slide Gates.
25.	AWWA C550	Protective Interior Coatings for Valves and Hydrants.
26.	ASTM D1418	Standard Practice for Rubber and Rubber Latices—Nomenclature.
27.	FS TT-C-494B	Coating Compound-Bituminous Solvent Type, Acid Resistant.

28. AISI 1144 Carbon Steel.

1.05 DESCRIPTION

A. The scope of this Section includes requirements for all process valves, four-inch diameter and larger, in accordance with applicable standards and regulations. In addition:

1. All other valves referenced in Schedule 40 05 53-1, located after the "End of Section" designation, shall be for liquid service, unless otherwise explicitly indicated for air or digester gas service. Valves for digester gas and air service have been specifically identified in Schedule 40 05 53-1.

2. Electric actuators for electrically actuated valves shall be provided by the valve manufacturers. Electric actuator motors shall conform to the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

B. All valves larger than four inches that are part of the Work are exposed valves, even though adjoining pipelines may be primarily specified under Section 33 06 01 - Schedule for Buried Piping.

1.06 QUALITY ASSURANCE

A. Quality Assurance Inspections:

1. Quality Assurance inspections may be made by NYCDEP Bureau of Engineering Design and Construction, Quality Assurance Section or its representative at the manufacturer’s facility.

2. Quality Assurance Inspections shall be in accordance with the requirements of the Contract Documents.

3. The Contract shall give ample notice to the Engineer prior to the beginning of any fabrication, so that QA inspection may be made.

4. QA inspections shall include (but no be limited to) the following activities:

a. Obtain representative material samples of main components.

b. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.

c. Perform visual and dimensional inspection of completed work.

d. Witness surface preparation and coating and lining operations, paint peel tests, and holiday tests.

e. Witness any required hydrostatic, shop leakage and performance tests.

B. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of 5 years of experience in the production of substantially similar valve equipment, and shall show evidence of satisfactory service in at least 5 installations.

C. Supply and Compatibility:

1. Each type of valve, inclusive of all sizes specified for that type of valve, shall be the product of one (1) manufacturer.

D. Welding Work:

1. All welding work, qualification, and inspections shall conform to the requirements of Section 05 05 23.01 - Welding, and is subject to Quality Assurance inspection.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Quality Assurance Requirements:

1) All information necessary and required to substantiate approval of a valve manufacturer in accordance with the quality assurance requirements of this Section.

b. Shop Drawings:

1) Associated valve tag number(s) as specified in Schedule 40 05 53-1, located after the "End of Section" designation.

2) Complete catalog information, descriptive literature, specifications, and identification of all materials of construction.

3) Product data sheets for make and model. The valve(s) with size(s) and option(s) being submitted for approval are specifically identified in the product data sheet(s).

4) Power and control wiring diagrams, including terminals and numbers.

5) Complete nameplate data of electric actuators.

6) Spare parts list.

7) Special tools list.

c. Calculations:

1) Sizing of electric actuators.

2) Sizing of operating mechanisms with extension stems.

3) Sizing of gear actuators.

4) Sizing of anchor bolts.

d. Operation and Maintenance Data: Submit complete manuals including:

1) Copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.

e. Samples:

1) 1 ft. of chain for chain wheel operated valves.

2. Information Submittals:

a. Material test reports representing all major components of valves and operators shall be submitted. All such components shall be traceable to the original heat and/or lot numbers unless otherwise approved.

b. Certificates of compliance with AWWA Standards, if applicable.

c. Certificate of chemical composition and compliance with ASTM standard for anchor and miscellaneous mounting bolts.

d. Certificate of suitability of all valve materials for the specified service.

e. Certified copies of shop test results and inspection data.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Valves and associated appurtenances shall be handled carefully. Valves which are dropped, dented, cracked, and/or otherwise damaged shall not be accepted.

2. Provide full-face protectors of waterproof material fastened to each side of the valve body to protect joints and the valve interior.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, and as per the requirements of the Contract Documents. In addition:

1. Provide spare part sets for the following types of valves:

a. Gate Valves: Each spare part set shall consist of the following:

1) One (1) set of gaskets.

2) One (1) set of glands.

3) One (1) set of bushings.

b. Butterfly Valves: Each spare part set shall consist of the following:

1) One (1) set of bearings.
2) One (1) set of bearing seals or O-rings.
3) One (1) set of packing.
4) One (1) disc seat (if replaceable).

c. Plug Valves: Each spare part set shall consist of the following:
1) One (1) set of gaskets.
2) One (1) set of packing.
3) One (1) set of upper and lower journal bearings.

d. Check Valves: Each spare part set shall consist of the following:
1) One (1) set of seat rings.
2) One (1) set of hinge bushings.
3) One (1) set of pins.

e. Ball Valves: Each spare part set shall consist of the following:
1) One (1) set of bearings.
2) One (1) set of bearing seals or O-rings.
3) One (1) set of packing.

2. The quantities of spare parts sets to be furnished as part of the Work are given in Table 40 05 53-1, below. Furnish the quantity of spare parts sets given in the table for each type and each size of valve included in this Section.

TABLE 40 05 53-1
QUANTITIES OF SPARE PARTS SETS TO FURNISH

Number of Valves Installed	Sets of Spare Parts Required
1 - 5	1
6 - 10	2
11 - 15	3
16 - 30	5
Greater than 30	5 + (1 for every 10 additional valves)

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment, products. In addition:

1. The following tools shall be furnished:

a. T-Handle Operating Wrenches: As specified herein.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gate Valves (Metal-Seated):
   1. J & S Valves, Huffman, TX.
   2. Or approved equal.

B. Position Indicators:
   1. Trumbull Industries, Inc., Youngstown, OH.
   2. Or approved equal.

C. Stainless Steel Bracket for Position Indicators:
   1. Trumbull Industries, Inc., Youngstown, OH.
   2. Or approved equal.

D. Plug Valves (Liquid Service):
   1. DeZurik, as manufactured by DeZurik APCO Hilton, Inc., Sartell, MN;
   2. Or approved equal.

E. Ball Valves (Rubber Seated):
   1. Henry Pratt Co., Aurora, IL;
   2. Or approved equal.

F. Check Valves for Liquid Service:
   1. VAG USA LLC., Cranberry Township, PA;
   2. Or approved equal.

G. Motor-Operators (Open/Close and Modulating):
   1. AUMA Actuators, Canonsburg, PA;
   2. EIM Controls, Houston, Texas.;
   3. Limitorque, Irving, TX;
   4. Rotork, Bath, United Kingdom;
   5. Or approved equal.

H. Position Indicators:
   1. Trumbull Industries, Inc., Youngstown, OH.

2. Or approved equal.

I. Stainless Steel Bracket for Position Indicators:

1. Trumbull Industries, Inc., Youngstown, OH.

2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Materials of Construction:

a. Compatibility for Service:

1) All materials of construction of the valves shall be confirmed suitable for the application by the valve manufacturer.

b. Wetted parts of the valve shall be protected from galvanic corrosion.

c. Ferrous Metals:

1) Cast iron of the valves, unless otherwise specified, shall conform to ASTM A 126, Class B.

d. Non-Ferrous Metals:

1) Non-ferrous metals shall be provided with standard composition and physical properties conforming to ASTM standards except as otherwise indicated.

2) All non-ferrous metals shall be made from new metals of purest commercial quality. Scrap can be used only when it is the result of the processes of manufacture of articles of similar composition.

3) Bronze items shall have one of the following compositions as specified herein:

a) Composition "A" conforming to ASTM B 61 (Alloy UNS No. C92200) or B 62 (Alloy UNS No. C83600).

b) Composition "B" conforming to ASTM B 61 (Alloy UNS No. C92200) or an approved standard composition having good wear and corrosion resisting qualities and sufficiently ductile for peening into dove-tail grooves.

c) Composition "C" conforming to ASTM B 584, Copper Alloy UNS No. C86500 or C86400; or ASTM B 21, Copper Alloy UNS No. C46400; or ASTM B 124, Copper Alloy UNS No. 37700.

d) Composition "D" conforming to ASTM B 584, Copper Alloy UNS No. C86200 or C86700; or B 21, Copper Alloy UNS No. C46400.

e. Metal Castings:

1) Castings shall be true to pattern, sound, smooth, and without injurious cold shuts, swells, lump scabs, scoria, sand holes, and/or other defects and imperfections.

2) Weld repair will not be allowed without the written permission of the Engineer.

a) Map all defects over ¼-in. wide or ¼-in. deep.

(1) If such defects add up to ten percent or more of the total open surface area, then the casting will be rejected unless waived by the Engineer.

b) Map defects smaller than ¼-in. if they are densely concentrated, and report to the Engineer for approval or repair.

c) Conduct repairs permitted by the Engineer per approved procedures.

(1) Any acceptable casting defect that affects the paint integrity shall be plugged or filled using approved methods and only with the consent of the Engineer.

3) All castings shall be thoroughly, inside and outside, free from sand and dust.

a) Use wire brushes, scrapers or other approved mechanical appliances for this purpose.

b) Do not use acid or other corrosive liquids in cleaning castings.

4) Deviation in casting thickness (for each valve):

a) For valve body castings having a standard thickness < 0.8-in.:

(1) Maximum deviation from the standard thickness: < 0.08-in.

b) For valve body castings having a standard thickness ≥ 0.8-in.:

(1) Maximum deviation from the standard thickness: ≤ 10% of standard thickness.

c) Maximum area of casting over which deficiencies in thickness extend: ≤ 50% of surface area.

5) Identification and Pressure Rating:

a) All valves shall have manufacturer's name and rated pressure cast in raised letters on the valve body.

6) Direction to Open:

a) All valves shall have permanent markings for direction to open.

2. End Connections:

a. Unless otherwise explicitly shown or specified, valves shall be furnished with the following end connections:

1) For exposed valves:

a) Shall have flanged ends.

b) Flanges shall conform to:

(1) For Class 150 valves: ANSI B16.1, Class 125.

(2) For Class 250 valves: ANSI B16.1, Class 250 and Class 300.

c) Pressure class of valve flanges shall be based on pressure class of connected piping as specified in Section 40 06 01 - Schedule for Exposed Piping.

2) For buried valves:

a) Shall be provided with one of the following:

(1) Mechanical or push-on joints, based on connected piping specified in Section 33 06 01 - Schedule for Buried Piping.

(2) Joints shall be restrained or unrestrained, based on connected piping specified in Section 33 06 01 - Schedule for Buried Piping.

3. Operation:

a. Manual operators shall include hand wheel, chain, crank, lever and a T-handle operating wrench.

b. Direction: clockwise to close (unless otherwise specified in Schedule 40 05 53-1 - located after the "End of Section" designation).

c. Force required to open or close manual valves: ≤ 40-lbf.

1) Applies to all manual valves, with or without extension stems.

2) Shall apply to open or close against the specified criteria for the adjoining pipeline specified in:

a) Section 40 06 01 - Schedule for Exposed Piping.

b) Section 33 06 01 - Schedule for Buried Piping.

d. Design pull force on manual operator: ≥ 200-lbf.

e. Design input torque on actuator nut: ≥ 300 ft-lbs.

4. All valves shall be constructed such that operation at the lower range of operating pressures specified shall not result in any leakage.

B. Gate Valves (Metal-Seated):

1. General:

a. Metal seated gate valves shall conform to the requirements of AWWA C500.

b. Types:

1) Unless double disc type (or another type) is specified in Schedule 40 05 53-1, located after the "End of Section" designation, valves shall be solid wedge gate type.

c. Design Working Pressures:

1) For valves ≤ 12-in.: 200 psig.

2) For valves > 12-in.: 150 psig.

d. Maximum Fluid Temperature: 150°F, unless a higher temperature is specified in Schedule 40 05 53-1, located after the "End of Section" designation.

e. Where shown on the Contract Drawings, bypasses shall be provided for valves 16 in. and larger. Bypasses shall be of bolted construction and the bypass valves shall be similar to the main valves. Minimum size of the bypass valves shall be as specified in AWWA C500.

2. Materials:

a. All materials of construction shall conform to the requirements of AWWA C500.

b. The materials of construction for the various components of each valve shall be as follows:

1) Body, Bonnet, Stuffing Box, and Discs: Gray iron or ductile iron.

2) Seat and Disc Rings: Bronze, Composition "A".

3) Stem and Stem Nut:

a) For valves ≤ 24-in.: Bronze, Composition "C".

b) For valves > 24-in.: Bronze, Composition "D".

4) Disc Pin and Side Spreader: Bronze.

5) Top and Bottom Wedge Nuts: Cast iron with integrally cast bronze bushing.

6) Guide Contacts for valves ≥ 16-in.: Bronze.

7) Rollers and Tracks: Bronze.

8) All internal and external bolting and other hardware including pins, set screws, studs, bolts, nuts and washers: Type 316 stainless steel.

9) All Rubber Items: Acrylonitrile butadiene synthetic rubber.

3. Construction:

a. Provide NRS for:

1) Exposed valves: ≤ 48-in.

b. Provide OS&Y for:

1) Buried valves 4-in. through 12-in.

c. Tongue-and-groove guides:

1) Provided for all solid-wedge gate valves.

4. Appurtenances:

a. Gear Actuators for Manual Valves:

1) Each valve shall be provided with gear actuators conforming to the requirements of AWWA C500.

a) The gear actuators shall be sized for maximum differential pressures as specified herein.

b. Position indicators:

1) Provide all NRS valves for exposed service with position indicators.

C. Plug Valves (Liquid Service):

1. General:

a. All plug valves shall be of rectangular port, eccentric type unless otherwise specified.

1) Minimum Port Area: 100% of nominal pipe area.

a) Plug valves shall permit pigging with pigs equal to the interior diameter of the connected piping.

b. Design Working Pressures:

1) For valves ≤ 12-in.: 175 psig.

2) For valves > 12-in.: 150 psig.

c. Maximum Fluid Temperature: 180°F.

2. Materials:

a. The materials of construction for the various components of each valve shall be as follows:

1) Body: Ductile-iron, Grade 65-45-12.

a) Shall conform to the requirements of ASTM A 536.

2) Plug Core: Ductile-iron, Grade 65-45-12.

a) Shall conform to the requirements of ASTM A 536,

3) Plug Facing: Neoprene.

a) Hardness: ≥ 70 (Shore A) durometer.

4) Seats:

a) Overlay:

(1) Nickel content: ≥ 90%.

5) Stem Bearings: Type 316 stainless steel, that has been sintered and oil-impregnated.

6) Seal: Neoprene.

7) All internal and external bolting and other hardware including pins, set screws, studs, bolts, nuts and washers: Type 316 stainless steel.

3. Construction:

a. Plug:

1) Shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft.

a) The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure.

2) Shall be supported to top bearing by the use of spring that is externally adjustable.

3) For valves ≤ 6-in.:

a) Plugs shall be fully encapsulated with rubber.

4) For valves > 6 in.

a) Plugs with rubber facing shall be furnished, unless fully encapsulated plugs are specified herein.

5) Thickness of rubber lining: ≥ ⅛-in.

6) The rubber to metal bond shall withstand minimum 75 lbf. pull conforming to ASTM D 429, Method B.

b. Seats:

1) Shall have a welded overlay ≥ ⅛-in. thick.

2) Overlay shall cover all surfaces contacting the plug face.

c. Valves shall provide drip-tight bi-directional shutoff at the design working pressure, operating pressures, and test pressures.

d. Stem seal shall be multiple V-Ring type.

e. Stem bearings shall be permanently lubricated.

f. Packing and packing gland:

1) Shall be accessible without disassembly of the valve; and

2) Shall be externally adjustable; and

3) Shall be accessible for adjustment without requiring the removal of actuator from the valve.

4. Appurtenances:

a. Valves shall be tagged or marked by the manufacturer to indicate the proper mounting position as specified herein.

b. Gear Actuators for Manual Valves:

1) Each valve shall be provided with gear actuators as specified herein, except:

a) 4-in. valves located < 6 ft. above the operating floor.

2) The gear actuators shall be sized for the following differential pressures:

a) For valves ≤ 8-in.: 175 psig.

b) For valves > 8-in.: 100 psig, unless a greater pressure differential is specified in Schedule 40 05 53-1, located after the "End of Section" designation.

D. Ball Valves (Rubber Seated):

1. General:

a. Rubber seated ball valves shall conform to the requirements of AWWA C507.

b. Design Working Pressure: 150 psig, unless a higher pressure is specified in Schedule 40 05 53-1, located after the "End of Section" designation.

c. Maximum Gas Temperature: 180°F, unless a higher temperatures is specified in Schedule 40 05 53-1, located after the "End of Section" designation.

d. Sizes: 6-in., up to and including 48-in.

2. Materials:

a. The materials of construction for the various components of each valve shall be as follows:

1) Body: Gray iron, ductile iron, or cast steel.

2) Ball: Gray iron, ductile iron, or cast steel.

3) Rubber Seats in Body, Bearing Seal O-Rings, and Packing: Acrylonitrile butadiene synthetic rubber, or another synthetic rubber suitable for the application.

4) Seating Surface on Ball: Type 316 stainless steel or nickel-chrome.

5) Shaft: Type 316 stainless steel.

6) Tapered Pins for Attachment of Shaft to Ball: Type 316 stainless steel.

7) Bearings: Polytetrafluoroethylene -lined with fiberglass backing, self-lubricating.

8) Thrust Collar and Stud Bolt of Thrust Bearing Assembly: Type 316 stainless steel.

9) Shaft Seals: Self-adjusting V-type chevron packing, material same as of rubber seats.

10) All internal and external bolting and other hardware including pins, set screws, studs, bolts, nuts and washers: Type 316 stainless steel.

3. Construction:

a. The body shall have full, unobstructed, circular inlet and outlet port diameters equal to the nominal size of the valve and the connected piping.

b. The valve bodies shall have support legs or pads to support the valve and actuator weight when installed in a horizontal pipeline.

c. The ball assembly shall be supported by a two-way thrust bearing assembly consisting of a stud and thrust collar in a grease packed cavity suitable for lifetime lubrication.

d. The valves shall provide drip-tight bi-directional shut-off at the design working pressure as well as operating pressure.

e. Valve seats shall seal a full 360° circumference without interruption.

f. Valve seats shall be field adjustable around the 360° circumference and replaceable without dismantling the operator, shaft or ball.

g. Packing shall be:

1) Self-adjusting, chevron type; and

2) Shall be accessible without having to dismantle the valve.

4. Appurtenances:

a. Gear Actuator for Manual Valves:

1) Gear actuators shall conform to the requirements AWWA C507.

2) The gear actuators shall be sized for the following differential pressures:

a) For valves ≤ 10-in.: Shall be sized for the differential pressure equal to the design working pressure of the valve and port velocity of 35 ft/s.

b) Fr valves > 10-in.: Shall be sized for maximum differential pressures and flow velocities as specified in Schedule 40 05 53-1, located after the "End of Section" designation.

E. Check Valves (Liquid Service):

1. General:

a. Check valves shall conform to the requirements of AWWA C508.

b. Design Working Pressure:

1) For check valves < 12-in.: 175 psig.

2) For check valves ≥ 12-in.: 150 psig.

c. Sizes: ≤ 24-in.

d. Type: Swing style, resilient-seated.

e. Check valves shall be suitable for horizontal or vertical mounting.

f. Check valves shall be air or hydraulically cushioned.

2. Materials of Construction:

a. All materials of construction shall conform to the requirements of AWWA C508.

b. The materials of construction for the various components of each valve shall be as follows:

1) Body, Disc, Cover and Gland: Cast-iron.

2) Disc Arm: Ductile iron.

3) Hinge Shaft: Type 316 stainless steel.

4) Hinge Shaft Bushings: Bronze, ASTM B 62, Alloy UNS C83600.

5) Shaft End Plate: Type 316 stainless steel.

6) Body Seat and follower ring on rubber seat on disc: Type 316 stainless steel.

7) Disc Center Pin Assembly: Type 316 stainless steel.

8) Air Cushion Chamber:

a) Chamber and Plunger: Bronze, ASTM B 62, Alloy UNS C83600.

b) Linkages and Pins: Type 316 stainless steel.

c) Air Check Valve and Tubing: Brass.

9) All Rubber Items:

a) For service ≤ 180°F: Acrylonitrile butadiene synthetic rubber.

b) For service > 180°F: ASTM D1418 FKM fluoropolymer elastomer synthetic rubber.

10) All internal and external bolting and other hardware including pins, set screws, studs, bolts, nuts and washers: Type 316 stainless steel.

11) Gland Packing: Graphite and Kevlar.

3. Construction:

a. Check valves shall have a clear waterway with full open area equal to the pipe size.

b. Check valves shall be provided with outside adjustable weight and lever.

c. For check valves > 6 in.:

1) Provide adjustable air cushion chambers.

d. Check valve seats shall be:

1) Field replaceable; and

2) Valve seats shall be mechanically attached.

F. Check Valves (Air Service):

1. General:

a. Design Working Pressure: 125 psig.

b. Operating Pressure: As specified in Schedule 40 05 53-1, located after the "End of Section" designation.

c. Internal Temperature Rating: 250°F.

d. Maximum head loss at design operating condition: As specified in Schedule 40 05 53-1, located after the "End of Section" designation.

e. Type: double door; spring loaded.

2. Materials of Construction:

a. Body: Type 316 stainless steel.

b. Double Doors: Aluminum alloy.

c. Hinge and Stop Shafts: Type 316 stainless steel.

d. Springs: Type 316 stainless steel.

e. Seal Material: ASTM D1418 FKM fluoropolymer elastomer synthetic rubber.

f. All internal and external bolting and other hardware including pins, set screws, studs, bolts, nuts and washers: Type 316 stainless steel.

3. Construction:

a. Check valves shall be tight seating against operating back pressure with zero leakage.

b. Check valves shall operate without hammer or shock.

G. Gear Actuators for Manual Valves:

1. General:

a. Gear actuators shall be designed to hold the valve in any intermediate position without creeping or vibrating.

2. Materials:

a. Housing: Cast Iron, ASTM A126, Class B.

b. Gear Sector: Ductile Iron, ASTM A536.

c. Worm Gear: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.

d. All Bearings: Bronze oil impregnated.

e. All Hardware including Bolts, Nuts, Washers, Set Screws and Pins: Type 316 stainless steel.

3. Construction:

a. Each actuator shall have all gearing totally enclosed.

b. The operator shaft and the gear sector shall be supported on permanently lubricated bronze bearings.

c. Metal encased spring loaded seals shall be provided in top and bottom covers of the gear housing.

d. Diameter ratio of the handwheel or the chainwheel and the gear sector: < 2.

e. For buried or submerged valves, the gear actuator shall be grease-packed and designed to withstand submersion and be droptight in water to 20 ft. head.

4. Appurtenances:

a. A valve position indicator shall be provided on each actuator. Stop-limiting devices shall be provided for open and closed position.

b. An adjustable stop shall be provided to adjust the seating pressure.

H. Electric Actuators (Open/Close):

1. General:

a. Electric actuators for open/close service shall conform to the requirements of AWWA C542.

b. Application Criteria:

1) Ambient Temperature Rating: -20°F to +150°F.

2) Ambient Humidity: 100%.

3) Maximum design differential pressures and forward/reverse flows applicable to the valves:

a) Refer top Schedule 40 05 53-1, located after the "End of Section" designation.

b) For the service conditions of buried piping on which the actuated valve is installed, refer to Section 33 06 01 – Schedule for Buried Piping.

c) For the service conditions of exposed piping on which the actuated valve is installed, refer to Section 40 06 01.

4) Opening and Closing Speeds: 30 to 90 sec.

5) Power Supply: 480 volts, 3 phase, 60 Hz.

6) Control Voltage: 120 volts, single phase, 60 Hz.

7) Torques: Per valve manufacturer.

8) Duty Cycle: ≥ 6 starts / hr.

9) Each electric actuator shall be equipped with a handwheel for manual operation.

a) The handwheel shall be connected such that operation by the motor will not cause the handwheel to rotate.

b) Should power be returned to the motor while the handwheel is in use, design of the unit shall prevent transmission of the motor torque to the handwheel.

10) The actuator shall be operable with handwheel or chainwheel even after the electric motor has been disengaged and removed for repairs.

c. Remote Control Panels:

1) Provide separate remote control panels for all valves with electric actuators located ≥ 6.00 ft. above the operating floor.

2) The separate remote control panels shall be provided with separate push-button stations.

3) The separate remote control panels shall be installed approximately 5 ft. above the operating floor at an approved location.

4) Electrical wiring shall be modified as required for the remote location of the control panels.

d. Sizing of each electric actuator shall be coordinated with the valve manufacturer who shall furnish the valve and the electric actuator as a unit.

e. The electric actuators shall be suitable for the valve orientation as shown on the Contract Drawings.

f. All electrical components shall conform to the area classification shown on the Contract Drawings.

2. Materials and Construction:

a. Electric Motor:

1) Motor shall be in accordance with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

2) Motor shall be specifically designed for valve actuator service. It shall have high torque characteristics and shall have a maximum continuous total temperature rating of 70°C.

3) The motor shall be sized for at least 1.5 times the actuator torque requirement.

b. Actuator Gearing:

1) Housing: Die-cast aluminum.

2) Close coupled to electric motor.

3) Input Shaft Gearing: Spur or bevel gear assembly.

4) Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration. The gearing shall be rated for twice the required actuator torque.

5) All gearing shall be of hardened alloy steel or a combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.

6) Lubrication: Oil bath or grease.

7) Bearings: Ball or roller with a minimum B-10 life of 100,000 hrs.

8) Input Shaft: Hardened alloy steel.

9) Provide mechanical stops adjustable from 0° to 90° at each end of travel.

c. Limit Switches:

1) Each actuator shall be provided with "end of travel" limit switches to allow control of desired end position for each direction of travel.

2) Travel stops shall be threaded and of Type 316 stainless steel to allow adjustment at each end of actuator stroke.

3) Open and close limit switches shall be geared to the drive mechanism and in step at all times, whether the unit is operated electrically or manually and whether or not the actuator is powered by the 3-phase power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.

4) Limit switch gearing shall be appropriately lubricated.

5) The driven mechanism shall be totally enclosed to prevent entrance of foreign matter or loss of lubricant.

6) Each actuator shall be provided with four auxiliary contacts. Two contacts shall close and two contacts shall open at a desired end position for each direction of travel.

7) Switches shall be rated 5A or 10A at 120V, as applicable for the specified equipment.

d. Torque Switches:

1) Adjustable torque switches shall be provided with each valve actuator.

a) The torque switches shall operate during the complete valve cycle without the use of auxiliary relays, linkages, latches or other devices.

2) Torque switches shall be wired to de-energize the valve actuator motor in the event excessive torque is developed during either direction of travel.

3) It shall be possible to select the torque switches to control the open and close limit positions in either direction of valve travel.

4) Dry contacts, 5A or 10A, 120V, as applicable for the specified equipment, shall be provided for remote high torque alarm for automatically controlled valves.

3. Appurtenances:

a. Handwheel and Chainwheel:

1) Provide each electric actuator with a handwheel.

2) Maximum Effort on Rim of Handwheel:

a) For seating or unseating Load: ≤ 80 lbf.

b) For Running Load: ≤ 60 lbf..

3) The handwheel shall have an arrow and the word "OPEN" or "CLOSE" indicating required rotation.

4) The handwheel shall operate in the clockwise direction to close.

5) Chain Operators:

a) All valves ≥ 6.00 ft. above the operating floor level shall be equipped with chain operators.

6) Handwheels and chain operators shall conform to the requirements specified separately herein.

b. All fasteners shall be Type 316 stainless steel.

4. Controls:

a. Provide each electric actuator with controls:

1) Provide controls in a separate compartment integral with the actuator.

2) Enclosure: NEMA 4X, unless NEMA 7 is required for duty in the actuator location .

3) Starter:

a) Provide a combination reversing magnetic starter with circuit breaker and disconnect switch.

b) Housing:

(1) For nonhazardous areas: NEMA 4X, Type 316 SS enclosure.

(2) For hazardous areas: Class 1 Division 2 cast aluminum housing.

4) Control Power Transformer:

a) Provide a transformer to transform the rated three phase, 60 Hz power to 120V, single phase.

b) The transformer shall be complete with a grounded and fused secondary and dual primary fuses.

5) Provide LOCAL/OFF/REMOTE Selector Switch. "LOCAL" position provides operation from open/close/stop push buttons.

a) "OFF" position disables local and remote operation.

b) "REMOTE" position enables open/close/stop control from a remote source.

6) Provide OPEN/CLOSE/STOP push buttons with a hold-to-run or momentary contact selection.

7) Provide OPEN/CLOSE/STOP indicating lights.

8) Provide thermal overload and single phasing protection of the motor.

9) Provide a set of dry contacts to remotely indicate that the actuator is available for remote operation.

10) The actuator circuit boards shall be rated for high temperature service, minimum 55°C.

11) Provide electrical interlocks as shown on the Contract Drawings.

12) For monitoring of the actuator, provide a set of SPDT dry contacts. The monitor relay shall indicate that the actuator is available for remote operation.

b. Remote Mounted Control Panels:

1) Provide a remote mounted control panel for each electric actuator where:

a) Required by the valve location, as specified herein; or

b) Shown on the Contract Drawings.

2) Enclosure: NEMA 4X, Type 316 stainless steel.

3) Provide LOCAL/OFF/REMOTE Selector Switch. "LOCAL" position provides operation from open/stop/close push buttons.

a) "REMOTE" position enables open/close/stop control from remote source.

b) "OFF" position disables local and remote operation. Provide contact when switch is in remote position for remote indication.

4) Provide OPEN/CLOSE/STOP push buttons with a hold-to-run or momentary contact selection.

5) Provide OPEN/CLOSE/STOP indicating lights and 0% to 100% position indication on liquid crystal display window.

I. Electric Actuators (Modulating)

1. General:

a. Electric actuator for modulating service shall conform to the requirements of AWWA C542.

b. Application Criteria:

1) Ambient Temperature Rating: -20°F to +150°F.

2) Ambient Humidity: 100%.

3) Maximum design differential pressures and forward/reverse flows applicable to the valves:

a) Refer top Schedule 40 05 53-1, located after the "End of Section" designation.

b) For the service conditions of buried piping on which the actuated valve is installed, refer to Section 33 06 01 – Schedule for Buried Piping.

c) For the service conditions of exposed piping on which the actuated valve is installed, refer to Section 40 06 01.

4) Opening and Closing Speeds: -- sec.

5) Power Supply: 480V, 3 phase, 60 Hz.

6) Control Voltage: 120 volts, single phase, 60 Hz.

7) Torque: Per valve manufacturer.

8) Duty Cycle: Continuous (minimum 1200 starts/stops per hour), unless otherwise specified herein.

9) Accepts 4 to 20 mA input to positioner.

10) Each electric actuator shall be equipped with a handwheel for manual operation.

a) The handwheel shall be connected such that operation by the motor will not cause the handwheel to rotate.

b) Should power be returned to the motor while the handwheel is in use, design of the unit shall prevent transmission of the motor torque to the handwheel.

11) The actuator shall be operable with handwheel or chainwheel even after the electric motor has been disengaged and removed for repairs.

c. Remote Control Panels:

1) Provide separate remote control panels for all valves with electric actuators located ≥ 6.00 ft. above the operating floor.

2) The separate remote control panels shall be provided with separate push-button stations.

3) The separate remote control panels shall be installed approximately 5 ft. above the operating floor at an approved location.

4) Electrical wiring shall be modified as required for the remote location of the control panels.

d. Sizing of each electric actuator shall be coordinated with the valve manufacturer who shall furnish the valve and the electric actuator as a unit.

e. The electric actuators shall be suitable for the valve orientation as shown on the Contract Drawings.

f. All electrical components shall conform to the area classification shown on the Contract Drawings.

2. Materials and Construction:

a. Electric Motor:

1) Motor shall be in accordance with the requirements of Section 26 05 91 - Low Voltage Electric Motors.

2) Motors shall be specifically designed for valve actuator service. It shall have a maximum continuous total temperature rating of 70°C.

3) The motor shall be sized for at least 1.5 times the actuator torque requirement.

b. Actuator Gearing:

1) Housing: Die-cast aluminum.

2) Close coupled to electric motor.

3) Input Shaft Gearing: Spur or bevel gear assembly.

4) Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration. The gearing shall be rated for at least twice the required actuator torque.

5) All gearing shall be of hardened alloy steel or a combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.

6) Lubrication: Oil bath or grease.

7) Bearings: Ball or roller with a minimum B-10 life of 100,000 hrs.

8) Input Shaft: Hardened alloy steel.

9) Provide mechanical stops adjustable to ±5° at each end of travel.

10) Provide mechanical position indication.

c. Limit Switches:

1) Each actuator shall be provided with "end of travel" limit switches to allow control of desired end position for each direction of travel.

2) Travel stops shall be threaded and of Type 316 stainless steel to allow adjustment at each end of actuator stroke.

3) Open and close limit switches shall be geared to the drive mechanism and in step at all times, whether the unit is operated electrically or manually and whether or not the actuator is powered by the 3-phase power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.

4) Limit switch gearing shall be appropriately lubricated.

5) The driven mechanism shall be totally enclosed to prevent entrance of foreign matter or loss of lubricant.

6) Each actuator shall be provided with four auxiliary contacts. Two contacts shall close and two contacts shall open at a desired end position for each direction of travel.

7) Switches shall be rated 5A or 10A at 120V, as applicable for the specified equipment.

d. Torque Switches:

1) Adjustable torque switches shall be provided with each valve actuator.

a) The torque switches shall operate during the complete valve cycle without the use of auxiliary relays, linkages, latches or other devices.

2) Torque switches shall be wired to de-energize the valve actuator motor in the event excessive torque is developed during either direction of travel.

3) It shall be possible to select the torque switches to control the open and close limit positions in either direction of valve travel.

4) Dry contacts, 5A or 10A, 120V, as applicable for the specified equipment, shall be provided for remote high torque alarm for automatically controlled valves.

3. Appurtenances:

a. Handwheel and Chainwheel:

1) Provide each electric actuator with a handwheel.

2) Maximum Effort on Rim of Handwheel:

a) For seating or unseating Load: ≤ 80 lbf.

b) For Running Load: ≤ 60 lbf..

3) The handwheel shall have an arrow and the word "OPEN" or "CLOSE" indicating required rotation.

4) The handwheel shall operate in the clockwise direction to close.

5) Chain Operators:

a) All valves ≥ 6.00 ft. above the operating floor level shall be equipped with chain operators.

6) Handwheels and chain operators shall conform to the requirements specified separately herein.

b. All fasteners shall be Type 316 stainless steel.

4. Controls:

a. Provide each electric actuator with controls:

1) Provide controls in a separate compartment integral with the actuator.

2) Enclosure: NEMA 4X, unless NEMA 7 is required for duty in the actuator location.

3) Starter:

a) Provide a combination reversing magnetic starter with circuit breaker and disconnect switch.

b) Provide a fused disconnect switch in a separate enclosure that is rated for the same area of classification.

c) Housing:

(1) For nonhazardous areas: NEMA 4X, Type 316 SS enclosure.

(2) For hazardous areas: Class 1 Division 2 cast aluminum housing.

4) Control Power Transformer:

a) Provide a transformer to transform the rated three phase, 60 Hz power to 120V, single phase.

b) The transformer shall be complete with a grounded and fused secondary and dual primary fuses.

5) Provide LOCAL/OFF/REMOTE Selector Switch.

a) "LOCAL" position provides operation from open/close/stop push buttons.

b) "OFF" position disables local and remote operation.

c) "REMOTE" position enables open/close/stop control from a remote source.

6) Provide OPEN/CLOSE/STOP push buttons with a hold-to-run or momentary contact selection.

7) Provide OPEN/CLOSE/STOP indicating lights.

8) Provide and 0% to 100% position indication on a liquid crystal display window.

9) Provide thermal overload and single phasing protection of the motor.

10) Provide a set of dry contacts to remotely indicate that the actuator is available for remote operation.

11) The actuator circuit boards shall be rated for high temperature service, minimum 55°C.

12) Provide electrical interlocks as shown on the Contract Drawings.

13) For monitoring of the actuator, provide a set of SPDT dry contacts. The monitor relay shall indicate that the actuator is available for remote operation.

b. Position controller:

1) Provide each electric actuator for modulating service with a position controller.

2) The position controller shall receive a 4-20 mA analog control signal and position the valve in proportion to this signal.

3) The controller shall have adjustments for duty cycle, band width, span, and zero.

4) On loss of control signal, the valve shall remain in its last position.

5) Provide for adequate cooling of the controller based on the service location of the actuator.

c. Position transmitter:

1) Provide each electric actuator for modulating service with a position transmitter capable of producing a 4-20 mA output signal.

2) Unit shall be a standard slidewire (potentiometer) position transducer which shall provide an output corresponding to 0% to 100% of travel.

3) Accuracy shall be ±1% of scale.

4) Transmitter shall include an integral temperature-compensated, constant-current source for slidewire excitation.

5) Transmitter shall be integral to the actuator.

d. Remote Mounted Control Panels:

1) Provide a remote mounted control panel for each electric actuator where:

a) Required by the valve location, as specified herein; or

b) Shown on the Contract Drawings.

2) Enclosure: NEMA 4X, Type 316 stainless steel.

3) Provide LOCAL/OFF/REMOTE Selector Switch. "LOCAL" position provides operation from open/stop/close push buttons.

a) "REMOTE" position enables open/close/stop control from remote source.

b) "OFF" position disables local and remote operation. Provide contact when switch is in remote position for remote indication.

4) Provide OPEN/CLOSE/STOP push buttons with a hold-to-run or momentary contact selection.

5) Provide OPEN/CLOSE/STOP indicating lights and 0% to 100% position indication on liquid crystal display window.

J. Appurtenances for Exposed Metallic Valves

1. Provide appurtenances for all exposed valves of metallic construction, unless otherwise specified.

2. Provide handwheels for all valves located < 6 ft. above the operating floor.

a. All handwheels shall conform to the applicable AWWA Standards.

b. Material of Construction: Ductile iron or cast aluminum.

c. Arrow indicating direction of opening and word "OPEN" shall be cast on the trim of the handwheel.

d. Maximum Handwheel Diameter: 30 inches.

3. Provide chain operators for all valves located ≥ 6 ft. above the operating floor.

a. Chains shall extend to three feet above the operating floor.

b. A ½-in. stainless steel hook bolt shall be provided to keep the chain out of the walking area.

c. Materials of Construction:

1) Chain: Type 316L stainless steel.

2) Chain wheel: Recessed groove type made out of Type 316 stainless steel.

3) Guards and Guides: Type 316L stainless steel.

d. Chain Construction: Chain shall be of welded link type with smooth finish. Chain that is crimped and has links type with exposed ends that may cause injury shall not be acceptable.

e. Provide geared operators where required to position chain wheels in vertical position.

4. Extension stems and floorstands:

a. Provide where indicated, necessary, or required.

b. Sizing of the complete lifting mechanism shall conform to the applicable requirements of AWWA C501.

c. Bench and Pedestal Floorstands:

1) The valves requiring extension stems shall be provided with bench or pedestal floorstands as indicated.

2) Type: Heavy-duty with tapered roller bearings enclosed in a weatherproof housing, provided with positive mechanical seals around lift nut and pinion shaft to prevent loss of lubrication and to prevent moisture from entering the housing. A lubrication fitting shall be provided for grease. The base shall be machined.

d. Extension Stems:

1) Maximum Slenderness Ratio (L/R): 100.

2) Minimum Diameter: 1.5 in.

3) Threads: ACME.

4) A top nut and a bottom coupling shall be provided on the stem with required pins and set screws.

e. Stem Guides:

1) Maximum Stem Length between Guides: 7 feet.

2) Stem guides shall be adjustable in two directions.

f. Materials of Construction:

1) Floorstand Housing: Cast-iron, ASTM A126, Class B.

2) Lift Nut: Cast bronze, ASTM B 98.

3) Wall Brackets for Floorstands: Type 316L stainless steel.

4) Stem and Stem Couplings: Type 316 stainless steel.

5) Top Nut, Bottom Coupling and Hardware: Type 316 stainless steel.

6) Stem Guides: Type 316 cast stainless steel.

7) Grease Fitting: Stainless steel.

8) All Bolting: Type 316 stainless steel.

g. Stem Covers:

1) Shall be furnished with clear butyrate plastic or grade 153 Lexan pipe stem covers.

2) The cover shall be furnished with a cast adaptor for mounting cover to bench and floor stands.

3) Stem cover shall be designed and furnished with gasketing and breathers to eliminate water intrusion into operator and condensation within the cover.

4) The cover shall be provided with Mylar tape with legible markings showing the gate position at one inch intervals and open/close limits of the gates.

5. Crank Operator:

a. Crank operator shall be removable and fitted with a rotating handle.

b. Maximum Radius of Crank: 15 in..

c. Materials:

1) Crank: Cast iron or ductile iron.

2) Handle: Type 304 stainless steel.

3) Hardware: Type 304 stainless steel.

K. Appurtenances for Buried Metallic Valves

1. Wrench Nuts:

a. Wrench nuts shall be provided on all buried valves and shall be of nominal 2-in. size conforming to AWWA C500.

b. Arrow indicating direction of opening the valve shall be cast on the nut along with the word "OPEN".

c. Material: Ductile iron.

d. The nut shall be secured to the stem by mechanical means.

2. T-Handle Operating Wrenches:

a. Contractor to provide from valve manufacturer.

b. Provide T-Handle operating wrenches in lengths to permit operation of all valves by operators.

c. Furnish one (1) wrench per type and size of each buried metallic valve installed.

3. Extension Stems for Non-Rising Stem Gate Valves and Quarter Turn Buried Valves:

a. Extension stems shall be provided to bring the operating nut to 6-in. below the box cover.

b. Minimum Size and Material: Same as valve stem.

c. Maximum Unsupported Length: 3 ft.

4. Valve Boxes:

a. Valve boxes shall be as indicated and as required.

b. Type: Heavy duty, suitable for highway loading, telescopic, and adjustable.

c. Material: Cast or ductile iron.

d. Coating: Two coats of asphalt varnish conforming to FS TT-C494B.

e. Marking: As required for service.

L. Anchor and Miscellaneous Mounting Bolts

1. All bolts, nuts and washers furnished for connection of the valve appurtenances to the concrete structure or other structural members shall be furnished by the valve equipment manufacturer, and shall be of ample size and strength for the purpose intended.

2. Anchor bolts shall be hooked or adhesive type.

3. All bolts and washers shall be of Type 316 stainless steel and nuts shall be UNS S21800 alloy stainless steel and shall conform to the requirements of ASTM A194 Grade 8SA.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General:

1. Stainless Steel:

a. Fabricated stainless steel items shall be cleaned and descaled in accordance with ASTM A380, and shall be as follows:

1) All stainless steel welded fabricated items shall be passivated after manufacture by immersion in a pickling solution of 6% nitric acid and 3% hydrofluoric acid.

a) Temperature and detention time shall be sufficient for removal of oxidation and ferrous contamination without etching of surface.

b) Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash.

2) The welds shall be scrubbed with the same pickling solution or pickling paste and stainless steel wire brushes after fabrication to remove weld discoloration, and then shall be neutralized and washed clean.

b. Anti-seize Compound:

1) For all stainless steel bolting, anti-seize compound, graphite free, shall be used to prevent galling.

2) Strength of bolting shall not be affected by anti-seize compound.

2. Painting of Exposed Valves and Appurtenances:

a. Exterior steel, cast-iron, and ductile iron surfaces except machined or bearing surfaces of all exposed valves and appurtenances shall be finish painted in the shop.

b. The surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00 - Painting.

3. Painting of Buried Valves:

a. Exterior steel, cast-iron, and ductile iron surfaces except machined or bearing surfaces of all buried valves shall be shop-painted with two coats of asphalt varnish conforming to FS TT-C 494B.

4. Limit Switches:

a. Where shown on the Contract Drawings and/or specified, all control-closing swing check valves shall be provided with limit switches as specified and/or as shown in the contract documents.

5. Nameplates:

a. All valves shall be provided with Type 316 stainless steel nameplates attached with Type 316 stainless steel screws.

b. The nameplates shall have engraved letters and shall include the following information as a minimum:

1) Valve size.

2) Pressure and temperature ratings.

3) Date of manufacture.

4) Manufacturer's name and address.

6. Identification:

a. The valves shall be provided with identification conforming to the requirements of Section 40 05 97 - Identification for Process Equipment.

B. Gate Valves (Metal-Seated):

1. Interior Coating:

a. All metal-seated gate valves shall be coated inside.

b. The steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

C. Plug Valves (Liquid Service):

1. Interior Coating:

a. All plug valves shall be coated inside.

b. If the pipe connecting to the plug valve, as specified in Section 33 06 01 - Schedule for Buried Piping, and/or Section 40 06 01 -

Schedule for Exposed Piping, shall not have glass lining, the interior of the plug valve shall be coated as follows:

1) The steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

c. If the pipe connecting to the plug valve, as specified in Section 33 06 01 - Schedule for Buried Piping, and/or Section 40 06 01 - Schedule for Exposed Piping, shall have glass lining, the interior of the plug valve shall be glass lined as follows:

1) The interior of the valve body shall have glass confirming to the requirements specified herein.

D. Check Valves (Liquid Service):

1. Interior Coating:

a. All swing check valves for liquid service shall be coated inside.

b. The steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Gate Valves (Metal-Seated):

1. Test all metal-seated gate valves in accordance with the requirement of AWWA C500.

2. All shop tests shall be witnessed by a registered professional engineer who may be an employee of the manufacturer. The performance test reports shall be certified, signed, and sealed by the professional engineer.

3. The following shop tests shall also be witnessed by two (2) representatives of DEP:

a. All gate valves (metal-seated) included in Schedule 40 05 53-1, located after the "End of Section" designation.

b. Quantity of gate valve (metal-seated) shop tests that shall be witnessed by representatives of the DEP:

1) The shop tests for each individual gate valve (metal-seated) shall be witnessed.

4. The Contractor shall bear all costs for travel, lodging, and boarding of these representatives, for the shop witness tests. The Contractor shall bear all similar costs if the equipment must be retested.

5. In the event that the manufacturer is unable to demonstrate that a valve meets the test requirements, the deficient equipment shall be rejected. All rejected equipment shall be adjusted, modified or replaced and retested at no additional cost to the City.

6. Shop test all metal-seated gate valves in accordance with the requirement of AWWA C500.

B. Plug Valves (Liquid Service):

1. Perform shop tests on all plug valves for liquid service.
2. Open/Close Test:
   a. Each plug valve (with the actuator mounted directly on the valve) shall be shop operated three (3) times from the fully closed to the fully opened position and the reverse under a no-flow condition.
3. Leakage Tests:
   a. Plug valves shall be given a leakage test at the design working and operating pressures.
   b. During the test, the plug valves shall be drip-tight.
   c. Duration:
      1) For plug valves < 20-in.: 5 min.
      2) For plug valves ≥ 20-in.: 10 min.
   d. The tests shall be repeated with pressure in the opposite direction.
4. Hydrostatic Test:
   a. All plug valve bodies shall be subjected to an internal hydrostatic pressure equivalent to twice the rated pressure.
   b. During the hydrostatic test, there shall be no leakage through the metal, end joints, or shaft seal, nor shall any part be permanently deformed.
   c. The duration of the hydrostatic test shall be sufficient to allow visual examination for leakage.
   d. Duration:
      1) For plug valves ≤ 8-in.: 1 min.
      2) For plug valves 8-in. through 20 in.: 3 min.
      3) For plug valves > 20 in.: 10 min.
5. Glass Lining Continuity Test:
   a. The glass lining test applies only to plug valves for liquid service which have glass lining.
   b. Each plug valve shall be tested for continuous coverage of glass lining by a low voltage wet sponge holiday detection unit.
   c. Number of pinholes permitted in each plug valve lining: ≤ 2.

C. Check Valves (Liquid Service):

1. Shop test all swing check valves for liquid service in accordance with the requirements of AWWA C508.

    a. Permitted leakage at design working and operating pressures: 0.

D. Electric Actuators (Open/Close):

1. Shop test each actuator in accordance with the requirements of AWWA C542.

E. Electric Actuators (Modulating):

1. Shop test each actuator in accordance with the requirements of AWWA C542.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install valves in complete accordance with the manufacturer's printed instructions and the approved Shop Drawings.

B. All valves shall be installed plumb and level. The valves shall be free from distortion and strain caused by misaligned piping, equipment or other causes.

C. All valves shall be installed so that operating handwheels or levers may be conveniently turned from operating floor without interfering with access, and shall be as approved by the Engineer. Chain operators shall be oriented out of the way from the walking areas.

D. For motor-operated valves located less than 6.00 ft. above the operating floor, the orientation of the motor actuator shall permit easy access to the push buttons and the handwheel.

E. For buried valves:

1. The valve boxes shall be set plumb and centered.

2. Carefully tamp to a lateral distance of 4 ft. on all sides of the valve box.

3. If the undisturbed trench face is less than 4 ft. from the valve box in any direction, carefully tamp to the undisturbed trench face.

F. Installation of plug valves in sludge lines:

1. Plug valves in horizontal lines shall be installed with the stem horizontal. The plugs shall be on top when open and on pressure side when closed.

2. Plug valves in vertical lines shall be installed with the plug at the top when closed.

G. Provide identification accordance with the requirements of Section 40 05 97 - Identification for Process Equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. All parts and components shall be adjusted as required to provide correct operation.

B. A functional field test of each valve shall be conducted in the presence of the Engineer to demonstrate that each part and all components function together correctly.

3.04 STARTUP / DEMONSTRATION

A. Where specified herein, the Contractor shall provide the services of qualified factory-trained service technicians to check and approve the installation.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting in accordance with the requirements of Section 09 91 00 - Painting.

END OF SECTION

NO TEXT ON THIS PAGE

SCHEDULE 40 05 53-1
VALVE SCHEDULE, VALVES 4 INCH AND LARGER(1)

Valve Tag (No.):	Service:	Size: (in.)	Type:	Material:	Actuator:	End Type:	Remarks:
1602-20-03-IV 1603-20-03-IV 1604-20-03-IV 1605-20-03-IV 1606-20-03-IV	Raw Wastewater	20”	Gate Valve	DI	Mamual	Flg	Metal seated gate valve – Pump isolation
1602-20-03-CV 1603-20-03-CV 1604-20-03-CV 1605-20-03-CV 1606-20-03-CV	Raw Wastewater	20”	Check Valve	DI	Manual	Flg	Pump backflow prevention
1610-36-01-IV 1610-36-02-IV	Raw Wastewater	36”	Gate Valve	DI	Manual	Flg	Metal seated gate valve – Header isolation
1610-48-04_IV 1610-48-03-IV	Raw Wastewater	48”	Plug Valve	DI	Manuak	Flg	Eccentric plug valve – Forcemain isolation

Notes:
(1) Only valves to be permanently provided as part of the Work are included in Schedule 40 05 53-1.

A. The following service abbreviations are used in Schedule 40 05 53-1:

Service:	**Abbrev:**	**Service:**	**Abbrev:**
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--

B. The following valve type abbreviations are used in Schedule 40 05 53-1:

Valve Type:	**Abbrev:**
Gate Valve, Metal-Seated	GV
Gate Valve, Resilient-Seated	GV-RS
Thermoplastic Gate Valve	GVP
Plug Valve, Liquid Service	PV
Plug Valve, Digester Gas Service	PV-DG
Ball Valve, Rubber-Seated	BV
Thermoplastic Ball Valve	BVP
Butterfly Valve, Clean Water Service	BFV
Butterfly Valve, Air Service (Open/Close)	BFV-A-O/C
Butterfly Valve, High Performance for Air Service (Modulating Applications)	BFV-A-MOD
Butterfly Valve, Digester Gas Service (Open/Close)	BFV-DG-O/C
Butterfly Valve, High Performance for Digester Gas Service (Modulating Applications)	BFV-DG-MOD
Thermoplastic Butterfly Valve	BFVP
Check Valve, Liquid Service	CV
Check Valve, Air Service	CV-A
Check Valve, Digester Gas Service	CV-DG
Thermoplastic Check Valve	CVP
Thermoplastic Butterfly Check Valve	CVP-BF
Automatic Pressure Reducing Valve	PRV
Automatic Pressure Sustaining Valve	PSV
Automatic Electric Check Valve	CV-E
Telescopic Valve	Tel
Mud Valve	Mud

C. The following actuator type abbreviations are used in Schedule 40 05 53-1:

Actuator Type:	**Abbrev:**
Manual	Manual
Electric Actuators (Open/Close)	Elec(O/C)

Electric Actuators (Modulating)	Elec(Mod)
Pneumatic Actuators (Open/Close)	Pneu(O/C)
Pneumatic Actuators (Modulating)	Pneu(Mod)

D. The following valve material abbreviations are used in Schedule 40 05 53-1:

Pipe Material:	**Abbrev:**	**Pipe Material:**	**Abbrev:**
304L Stainless Steel	304L SS	Cast Iron	CI
316L Stainless Steel	316L SS	Chlorinated PVC	CPVC
Brass	Brass	Ductile Iron	DI
Carbon Steel	CS	Polyvinyl Chloride	PVC

E. The following valve end type abbreviations are used in Schedule 40 05 53-1:

Joint Type:	**Abbrev:**	**Joint Type:**	**Abbrev:**
Flanged	Flg	Shouldered End Coupling	SEC
Grooved End Coupling	GEC	Split-sleeve Coupling	SSC
Grooved / Shouldered End Coupling	GSEC	Solvent Weld	SW
Mechanical Joint	MJ	Restrained Mechanical Joint	RMJ
Push-on Joint	POJ	Restrained Push-on Joint	RPOJ

NO TEXT ON THIS PAGE

SCHEDULE 40 05 53-2
CONTROL VALVE Cv VALUES, VALVES 4 INCH AND LARGER

Valve Tag No.:	Size: (in.)	Medium:	Full Open Cv:	80% Open Cv:	20% Open Cv:

A. The following medium abbreviations are used in Schedule 40 05 53-2:

Medium:	**Abbrev:**
Compressed Air	Air
Digester Gas	DG
Incompressible Liquid	Liq

SCHEDULE 40 05 53-3
AUTOMATIC PRESSURE REDUCING VALVES, VALVES 4 INCH AND LARGER

Valve Tag No.:	**Size:** **(in.)**	**Medium:**	**Flow Rate (Max.):** **(gpm)**	**Flow Rate: (Min.)** **(gpm)**	**Upstream Pressure (Max.): (psig)**	**Upstream Pressure (Min.): (psig)**	**Setpoint Downstream Pressure: (psig)**

A. The following medium abbreviations are used in Schedule 40 05 53-3:

Medium:	**Abbrev:**
Compressed Air	Air
Digester Gas	DG
Incompressible Liquid	Liq

SCHEDULE 40 05 53-4
AUTOMATIC PRESSURE SUSTAINING VALVES, VALVES 4 INCH AND LARGER

Valve Tag No.:	**Size:** **(in.)**	**Medium:**	**Flow Rate (Max.):** **(gpm)**	**Flow Rate: (Min.)** **(gpm)**	**Upstream Pressure (Max.): (psig)**	**Upstream Pressure (Min.): (psig)**	**Setpoint Downstream Pressure: (psig)**

A. The following medium abbreviations are used in Schedule 40 05 53-4:

Medium:	**Abbrev:**
Compressed Air	Air
Digester Gas	DG
Incompressible Liquid	Liq

SECTION 40 05 56 – PROCESS VALVES SMALLER THAN FOUR-INCH DIAMETER

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all process valves smaller than four-inch diameter completely and operationally.

B. The following index of this Section is included for convenience.

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	11
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	12
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

C. The following schedule(s), attached after the End of Section designation, are a part of this Section:

1. Schedule 40 05 56-1, Process Valves Smaller than Four-inch Diameter.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting.

B. Section 33 06 01 – Schedule for Buried Piping.

C. Section 40 05 97 – Identification for Process Equipment.

D. Section 40 05 53 – Process Valves Four-inch Diameter and Larger.

E. Section 40 78 90 – PMCS Panel Mounted Instruments and Devices

F. Section 40 06 01 – Schedule for Exposed Piping.

1.04 REFERENCES

A. Definitions:

1. Non-ferrous Metals: Materials consisting of mixtures of copper, tin, zinc, lead, or other metals in which iron does not predominate.

B. Reference Standards:

1. ANSI B16.1 Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
3. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
4. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
5. ASTM A536 Standard Specification for Ductile Iron Castings.
6. AWWA C500 Metal-Seated Gate Valves for Water Supply Service
7. AWWA C508 Swing-Check Valves for Waterworks Service, 2 in. through 24 in.
8. AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
9. AWWA C542 Electric Motor Actuators for Valves and Slide Gates
10. Naval Publications and Form Center (NPFC) A-A-59326D General Specification for Coupling Halves, Quick-Disconnect, Cam-Locking Type.

1.05 DESCRIPTION

A. The scope of this Section includes requirements for all process valves smaller than four-inches, in accordance with applicable standards and regulations. In addition:

1. All other valves referenced in Schedule 40 05 56-1, located after the "End of Section" designation, shall be for liquid service, unless otherwise explicitly indicated for air or digester gas service.

2. Electric actuators for electrically actuated valves shall be provided by the valve manufacturers. Electric actuator motors shall conform to the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of 5 years of experience in the production of substantially similar valve equipment, and shall show evidence of satisfactory service in at least 5 installations.

B. Supply and Compatibility:

1. Each type of valve, inclusive of all sizes specified for that type of valve, shall be the product of one (1) manufacturer.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Quality Assurance Requirements:

1) All information necessary and required to substantiate approval of a valve manufacturer in accordance with the quality assurance requirements of this Section.

b. Shop Drawings:

1) Associated valve tag number(s) as specified in Schedule 40 05 56-1, located after the "End of Section" designation.

2) Complete catalog information, descriptive literature, specifications, and identification of all materials of construction.

3) Product data sheets for make and model. The valve(s) with size(s) and option(s) being submitted for approval are specifically identified in the product data sheet(s).

4) Power and control wiring diagrams, including terminals and numbers.

5) Complete nameplate data of electric actuators.

6) Spare parts list.

7) Special tools list.

c. Calculations:

1) Sizing of electric actuators, if applicable.

d. Operation and Maintenance Data: Submit complete manuals including:

1) Copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.

e. Samples:

1) 1 ft. of chain for chain wheel operated valves.

2. Information Submittals:

a. Material test reports representing all major components of valves and operators shall be submitted. All such components shall be traceable to the original heat and/or lot numbers unless otherwise approved.

b. Certificates of compliance with AWWA Standards, if applicable.

c. Certificate of suitability of all valve materials for the specified service.

d. Certified copies of shop test results and inspection data.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Valves and associated appurtenances shall be handled carefully. Valves which are dropped, dented, cracked, and/or otherwise damaged shall not be accepted.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, and as per the requirements of the Contract Documents. In addition:

1. The quantities of spare parts sets to be furnished are given in Table 40 05 56-1, below. Furnish the quantity of spare parts sets given in the table for each type and each size of valve included in this Section.

TABLE 40 05 56-1
QUANTITIES OF SPARE PARTS SETS TO FURNISH

Number of Valves Installed	Sets of Spare Valves Required
1-5	1
6-10	2
11-15	3
16-30	5
Greater than 30	5 + (1 for every 10 additional valves)

B. Tools: Provide standard and special tools and supplies necessary to service, disassemble, repair, and adjust the equipment, products.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solenoid Valves:

1. Automatic Switch Company, Florham Park, NJ;
2. Automatic Valve Corporation, Novi, MI;
3. Or approved equal.

B. Ball Valves:

1. Stockham Valves and Fitting Company, Cullman, AL;
2. CVC Valves, former Lunkenheimer Company, Cincinnati, OH;
3. Or approved equal.
4.

C. Check Valves:

1. Stockham Valves and Fitting Company, Cullman, AL;
2. CVC Valves, former Lunkenheimer Company, Cincinnati, OH;
3. Or approved equal.

D. Gate Valves:

1. Stockham Valves and Fitting Company, Cullman, AL;
2. CVC Valves, former Lunkenheimer Company Cincinnati, OH;
3. Or approved equal.

E. Electric Motor Actuators:

1. Limitorque, Lynchburg, VA;
2. Rotork Controls Inc., Rochester, NY;
3. EIM, Missouri City, TX;
4. AUMA Actuators, Canonsburg, PA;
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Materials of Construction:
    a. Compatibility for Service:
        1) All materials of construction of the valves shall be confirmed suitable for the application by the valve manufacturer.
    b. Wetted parts of the valve shall be protected from galvanic corrosion.
    c. Ferrous Metals:
        1) Cast iron of the valves, unless otherwise specified, shall conform to ASTM A126, Class A.
    d. Non-ferrous Metals:
        1) Non-ferrous Metals shall have standard composition and physical properties conforming to ASTM standards except as otherwise indicated.
    e. Metal Castings:
        1) All valves shall have manufacturer’s name and rated pressure cast in raised letters on the valve body.
        2) All valves shall have permanent markings for direction to open.
2. End Connections:
    a. Shall be (at a minimum) suitable for the test pressure of the piping connected to the valve in question, as specified in:
        1) For buried valves: Section 33 06 01 - Schedule for Buried Piping.

2) For exposed valves: Section 40 06 01 - Schedule for Exposed Piping.

3. Operation:

a. Direction: Clockwise to close (unless otherwise specified in Schedule 40 05 56-1, located after the "End of Section" designation).

4. All valves shall be constructed such that operation at the lower range of operating pressures specified shall not result in any leakage.

5. All valves shall be blowout proof.

B. Metallic Valves:

1. Solenoid Valves:

a. Type: Packless construction with screwed end connections and threaded conduit connection.

b. Materials: Bronze body and wetted parts with type 304 stainless steel hardware.

c. Coil: Continuous duty, epoxy encapsulated.

d. Failure Mode: Fail open, energize to close.

e. Electrical Power: 120 volt, 60 Hz, single phase.

f. Each solenoid valve shall be protected with a strainer upstream.

2. Ball Valves:

a. Body: Bronze, semi-steel or Type 316 Stainless Steel. as specified herein.

b. Ball, Stem Handle and Hardware: Type 316 stainless steel.

c. Seat, Packing and Gasket: Polytetrafluoroethylene.

d. End Connections: Screwed.

e. Rating: 150 psig Water, Oil or Gas (W.O.G.).

f. All ball valves shall be full port.

3. Check Valves:

a. Type: Swing, re-grindable bronze disc, screw-in cap.

b. Rating: 200 psig Steam Working Pressure (SWP).

c. For check valves smaller than 3-in.: valves shall conform to AWWA C508.

d. For check valves 3-in. and larger: Conform to the requirements of Section 40 05 53 - Process Valves Four-inch Diameter and Larger.

e. Bolts: Type 316 stainless steel, conforming to ASTM A193, Grade B.

4. Gate Valves:

a. Type: Solid wedge, rising stem.

b. Wetted Parts: 316 Stainless Steel

c. Handle and Hardware: Type 316 stainless steel.

d. Rating: 150 psig Water, Oil or Gas (W.O.G.).

e. For Valves ≥ 3-in.: Provide resilient seated gate valves conforming to the requirements of Section 40 05 53 – Process Valves Four-inch Diameter and Larger, regardless of diameter.

f. Bolts: Type 316 stainless steel, conforming to ASTM A193, Grade B.

C. Valves for Thermoplastic Piping

1. Ball Valves:

a. Type: True union, full port.

b. Body and Ball: Poly (Vinyl Chloride) (PVC) Compounds, ASTM D 1784.

c. Stem: Type 316 stainless steel.

d. Seats: Polytetrafluoroethylene.

e. Seals: Fluoropolymer elastomer synthetic rubber.

f. O-Rings: Ethylene propylene diene monomer rubber.

g. End Connections: Socket solvent welded unions or flanges as required.

h. Rating: 150 psig at 73°F.

2. Check Valves:

a. Type: True union, ball.

b. Body and Ball: CPVC Compounds, ASTM D 1784.

c. Seats: Polytetrafluoroethylene.

d. Seals: Fluoropolymer elastomer synthetic rubber.

e. O-rings: Ethylene propylene diene monomer rubber.

f. End Connections: Socket solvent welded unions or flanges as required.

g. Rating: 150 psig at 73°F.

D. Electric Motor Actuators:

1. General:
    a. Electric motor actuators shall conform to the requirements of AWWA C542.
    b. Type: Open-Close, reversing.
    c. Open-Close Time for Ball Valves: 10 sec.
    d. Open-Close Time for Diaphragm Valves: $\leq$ 60 sec.
2. Materials and Construction:
    a. Housing: NEMA 4X with corrosion resistant epoxy coating.
    b. Power: 120 vac, 60 Hz, single phase.
    c. SPDT switches shall be provided for remote valve position indication.
    d. Space heater and thermostat shall be provided in the housing.
    e. Integral thermal overload protection shall be provided with automatic reset.
    f. Limit switches shall be in accordance with the requirements for electric motor actuators specified in Section 40 05 53 - Process Valves Four-inch Diameter and Larger.

E. Appurtenances and Miscellaneous Items
1. Corporation Stops:
    a. Type: AWWA standard tapered thread, ball valve.
    b. Material: Bronze.
    c. End Connection:
        1) Copper Pipe: Threaded flare.
        2) Thermoplastic Pipe: Compression with Type 304 stainless steel stiffener rings.
2. Quick Connect Couplings - Water Service:
    a. Type: Dual cam and groove, male end dimensionally meeting the requirements of A-A-59326D, with dust cap, Type 304 stainless steel chain and lock.
    b. Body: Cast iron.
    c. Cam Arms: Type 304 stainless steel.
    d. Gaskets: Acrylonitrile butadiene synthetic rubber.
3. Valve Boxes, Floor Boxes and Operating Wrenches:

a. Provide in accordance with Section 40 05 53 – Process Valves Four-inch Diameter and Larger.

4. Valve Chain Operators:

a. All ball valves 1½-in. and larger located more than 6 ft.-0 in. above the operating floor level shall be equipped with a manual gear operator mounting assembly and a chain operator adapted to fit the gear operator, chain guide and sprocket wheel bolted directly to the valve operating wheel.

b. Aluminum or type 316 stainless steel chain shall be provided to hang three feet above the operating floor. All operators shall be equipped with a ½-in. hook bolt located to keep chain out of walking areas or to permit access to equipment.

c. Chain shall be of welded link type with smooth finish. Chain that is crimped and has links type with exposed ends that may scratch or cut the operator shall not be acceptable.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General:

1. Painting of Exposed Valves and Appurtenances:

a. Exterior steel, cast-iron, and ductile iron surfaces except machined or bearing surfaces of all exposed valves and appurtenances shall be finish painted in the shop.

b. The surface preparation, priming, finish painting, and field touch-up painting shall conform to the requirements of Section 09 91 00 – Painting.

2. Nameplates:

a. All valves shall be provided with Type 316 stainless steel nameplates attached with Type 316 stainless steel screws.

b. The nameplates shall have engraved letters and shall include the following information as a minimum:

1) Valve size.

2) Pressure and temperature ratings.

3) Date of manufacture.

4) Manufacturer's name and address.

3. Identification:

a. The valves shall be provided with identification conforming to the requirements of Section 40 05 97 – Identification for Process Equipment.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop test all valves in accordance with the manufacturer's standard test procedures. In addition:

1. Shop test the following valves in conformance with the following, additional requirements:

a. Test the following sizes of metal-seated gate valves in accordance with the requirements of AWWA C500.

1) Metal-seated gate valve sizes: ≥ 3-in.

b. Test the following sizes of resilient-seated gate valves in accordance with the requirements of AWWA C509.

1) Resilient-seated gate valve sizes: ≥ 3-in.

c. Test the following sizes of swing check valves in accordance with the requirements of AWWA C508.

1) Swing check valve sizes: ≥ 2-in.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install valves in complete accordance with the manufacturer's printed instructions and the approved Shop Drawings.

B. All valves shall be installed plumb and level. The valves shall be free from distortion and strain caused by misaligned piping, equipment or other causes.

C. All valves shall be installed so that operating handwheels or levers may be conveniently turned from operating floor without interfering with access, and shall be as approved by the Engineer. Chain operators shall be oriented out of the way from the walking areas.

D. For motor-operated valves located less than 6.00 ft. above the operating floor, the orientation of the motor actuator shall permit easy access to the push buttons and the handwheel.

E. For buried valves:

1. The valve boxes shall be set plumb and centered.

2. Carefully tamp to a lateral distance of 4 ft. on all sides of the valve box.

3. If the undisturbed trench face is less than 4 ft. from the valve box in any direction, carefully tamp to the undisturbed trench face.

F. Provide identification accordance with the requirements of Section 40 05 97 – Identification for Process Equipment.

3.03 FIELD TESTING / QUALITY CONTROL

A. All parts and components shall be adjusted as required to provide correct operation.

B. A functional field test of each valve shall be conducted in the presence of the Engineer to demonstrate that each part and all components function together correctly.

3.04 STARTUP / DEMONSTRATION

A. Where specified herein, the Contractor shall provide the services of qualified factory-trained service technicians to check and approve the installation.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting in accordance with the requirements of Section 09 91 00 – Painting.

END OF SECTION

SCHEDULE 40 05 56-1
VALVE SCHEDULE, SMALLER THAN 4-INCHES(1)

Valve Tag (No.):	Service:	Size: (in.)	Type:	Material:	Actuator:	End Type:	Remarks:

Notes:
(1) Only valves to be permanently provided as part of the Work are included in Schedule 40 05 56-1.

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A. The following service abbreviations are used in Schedule 40 05 56-1:

Service:	**Abbrev:**	**Service:**	**Abbrev:**
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--

B. The following valve type abbreviations are used in Schedule 40 05 56-1:

Valve Type:	**Abbrev:**
Solenoid Valve	Sol
Ball Valve	BV
Globe Valve	GLV
Check Valve	CV
Gate Valve	GV
Needle Valve	NV
Pressure Reducing Valve	PRV
Hose Bib	HBib
Plug Valve	PV
Pinch Valve	PnchV
Thermoplastic Ball Valve	BVP
Thermoplastic Check Valve	CVP
Thermoplastic Diaphragm Valve	DVP
Thermoplastic Butterfly Valve	BFVP

C. The following actuator type abbreviations are used in Schedule 40 05 56-1:

Actuator Type:	**Abbrev:**
Manual	Manual
Electric Actuators (Open/Close)	Elec(O/C)

D. The following valve material abbreviations are used in Schedule 40 05 56-1:

Pipe Material:	**Abbrev:**	**Pipe Material:**	**Abbrev:**
304L Stainless Steel	304L SS	Cast Iron	CI
316L Stainless Steel	316L SS	Chlorinated PVC	CPVC
Brass	Brass	Ductile Iron	DI
Carbon Steel	CS	Polyvinyl Chloride	PVC

E. The following valve end type abbreviations are used in Schedule 40 05 56-1:

Joint Type:	**Abbrev:**	**Joint Type:**	**Abbrev:**
Flanged	Flg	Soldered	Sld
Grooved End Coupling	GEC	Solvent Weld	SW
Grooved / Shouldered End Coupling	GSEC	Threaded	Thd
Shouldered End Coupling	SEC	--	--

SECTION 40 05 59.05 – STAINLESS STEEL SLIDE GATES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances to furnish, install, and test all stainless steel slide gates, completely and operationally.

B. Gates and operators shall be supplied by the gate manufacturer with all the necessary parts and accessories indicated on the Contract Drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates. These parts include, but are not limited to, slide gate frames and slides, guides, seat facings, seals, actuators and lifting systems including stem, stem guides, stem covers and stop collars, and floor boxes.

C. The following index of this Section is included for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	8
PART 2	PRODUCTS	8
2.01	Manufacturers	8
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	22
2.04	Source Quality Control / Shop Tests	23
PART 3	EXECUTION	24
3.01	Examination / Preparation	24
3.02	Installation	24
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	25
3.05	Adjusting / Protection / Cleanup	26

D. The following schedule, attached after the End of Section designation, is a part of this Section:

1. Schedule 40 05 59.05-1, Stainless Steel Slide Gate Schedule.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 15 – Witness Shop Testing

B. Section 05 05 23.01 – Welding

C. Section 05 05 23.02 – Miscellaneous Metal Fastenings

D. Section 09 91 00 – Painting

E. Section 40 05 97 – Identification for Process Equipment

1.04 REFERENCES

A. Definitions

1. Environmental Product Declaration - A third-party-verified International Organization for Standardization (ISO) Series 14025 Type III declaration that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

B. Reference Standards

1.	ASTM A29	Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
2.	ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
3.	ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
4.	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
5.	ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
6.	ASTM A320	Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
7.	ASTM A395	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
8.	ASTM A536	Standard Specification for Ductile Iron Castings
9.	ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

10.	ASTM A582	Standard Specification for Free-Machining Stainless Steel Bars
11.	ASTM B98	Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
12.	ASTM B148	Standard Specification for Aluminum-Bronze Sand Castings
13.	ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
14.	ASTM D707	Standard Classification System and Basis for Specification for Cellulose Acetate Butyrate Molding and Extrusion Compounds (CAB)
15.	ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
16.	ASTM D3935	Standard Classification System and Basis for Specification for Polycarbonate (PC) Unfilled and Reinforced Material
17.	ASTM D5436	Standard Specification for Cast Poly (Methyl Methacrylate) Plastic Rods, Tubes, and Shapes
18.	AWWA C561	Fabricated Stainless-Steel Slide Gates
19.	AWWA C542	Electric Motor Actuators for Valves and Slide Gates
20.	ISO 14025 -	Environmental labels and declarations - Type III environmental declarations

1.05 DESCRIPTION

A. This Section includes requirements for providing stainless steel slide gates, including, but not limited to, gate operators, appurtenances, related controls, and accessories, in accordance with applicable standards and regulations. In addition:

1. Stainless steel slide gates and gate operators shall be constructed of materials suitable for use in the water and wastewater environment to which they will be exposed.

2. Stainless steel slide gates and gate operators shall meet the general design requirements set forth herein and the specific design and operating requirements listed in Schedule 40 05 59.05-1, located after the "End of Section" designation, and as shown on the Contract Drawings.

3. Design slide gates for specified seating or unseating pressures.

   a. Seating pressure shall be measured to the center of the slide gate.

   b. Unseating pressure shall be measured to the center of the slide gate.

   c. Structural design must consider the pressure difference from the invert.

4. Design the operating mechanisms based on the following loading:

   a. The minimum vertical load is fifty percent (50%) of the force, in pounds of force, on the gate resulting from the operating head acting on the horizontal centerline of the gate multiplied by the effective area of the gate, plus the weight of the slide and stem.

   b. The operating head is the distance from the centerline of the slide gate to the maximum water level of the channel within which the gate is located.

1.06 QUALITY ASSURANCE

A. Quality Assurance Inspections:

1. Quality Assurance inspections may be made by NYC DEP Bureau of Engineering Design and Construction, Quality Assurance Section or its representative at the manufacturer's facility.

2. Quality Assurance Inspections shall be in accordance with the requirements of the Contract Documents.

3. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication, so that Quality Assurance inspection may be made.

4. Quality Assurance inspections shall include (but no be limited to) the following activities:

   a. Obtain representative material samples.

   b. Verify traceability.

   c. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.

   d. Perform visual inspection of welding, as per applicable welding code.

   e. Perform visual and dimensional inspection of completed work.

   f. Witness passivation of stainless steel parts and tests for free iron contamination per ASTM A380 water wet and/or Ferroxyl test, as applicable.

B. Qualifications of Manufacturer:

1. The manufacturer shall have a minimum of fifteen (15) years of experience in the design and fabrication of stainless steel hydraulic slide gates of similar size, capacity, and type to those specified in Schedule 40 05 59.05-1, located after the "End of Section" designation, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

C. Supply and Compatibility:

1. All components shall be traceable to the original heat and/or lot numbers unless otherwise approved.

2. All stainless steel hydraulic slide gates included in this section shall be provided by the Contractor through a single, qualified stainless steel hydraulic slide gate manufacturer. The manufacturer shall also supply the following as part of the Work:

   a. Mounting plates.

   b. Self-containing frames.

D. Regulatory Requirements:

1. If the stainless steel hydraulic slide gate requirements of this Section and referenced standards or manufacturer requirements are in conflict, the more stringent provision shall apply.

E. Welding Work:

1. All welding work, qualifications, and inspections shall conform to the requirements of Section 05 05 23.01 - Welding, and shall be subject to Quality Assurance inspection.

F. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved shop drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples, inspecting welds, verifying dimensions, and finishing inspections.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

   a. Quality Assurance Requirements:

      1) The Contractor shall submit all information necessary and required to substantiate approval of a stainless steel hydraulic slide gate manufacturer in accordance with the quality assurance requirements of this Section.

      2) The contractor shall submit test reports for all shop tests, regardless of whether said shop test was witnessed.

   b. Schedule of deviations.

   c. Shop Drawings:

      1) Arrangement and erection drawings of the gates, operators and control equipment.

a) Clearly identify all materials for all components on all Shop Drawings.

2) Operating characteristics, including the conditions specified in Schedule 40 05 59.05-1, located after the "End of Section" designation.

d. Calculations:

1) Provide calculations showing that the design is such that the seat contact pressure does not exceed 600 psi at the design head and leaked rates indicated and calculated in accordance with AWWA C561.

2) All calculations shall be based on the hydraulic conditions specified in Schedule 40 05 59.05-1, located after the "End of Section" designation.

3) Submit the manufacturer's structural computations for approval, showing that stresses and deflections are within specified limits.

4) Submit calculations of anchor bolts, including concrete penetration. Indicate all forces on structures resulting from gate operation.

5) Submit computations for sizing of operator and stem and of bearing pressures on power screw threads.

6) Provide calculations showing that the design is such that the seat contact pressure does not exceed 600 psi at the design head and leaked rates indicated and calculated in accordance with AWWA C561

7) Submit leakage calculations or documentation based on the hydraulic conditions.

8) All required calculations listed above, shall be signed and sealed by a Professional Engineer licensed in the State of New York.

e. Operation and Maintenance Manuals.

2. Information Submittals:

a. The material supplier shall certify to the City the yield strength of the material from which the stem is to be fabricated.

b. Manufacturer's certified performance and material specifications, as specified.

c. Submit material test reports representing all major components of slide gates and operators. An affidavit of compliance of stainless

steel hydraulic slide gate manufacture with all applicable provisions of AWWA C561 and additions as specified.

B. Sustainability Submittals:

1. Environmental Product Declarations

a. The Contractor shall provide product-specific type III Environmental Product Declaration (EPD) conforming to ISO 14025, 14044.

2. Envision Submittals

a. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall coordinate with its vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Project Requirements. The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver all materials provided under this Section in accordance with the requirements of the Contract Document.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish spare parts and special tools necessary to service, disassemble, repair, and adjust all stainless steel hydraulic slide gates, and as per the requirements of the Contract Documents. In addition, the Contractor shall furnish the following:

1. For slide gates:

a. Two (2) threaded lift nuts of each size and type.

b. Two (2) stem couplings of each size and type, where couplings are provided for the installed gate.

2. For electric motor operators:

a. One (1) motor of each size.

b. One (1) torque switch of each size.

c. One (1) limit switch assembly of each size.

d. Six (6) pushbuttons.

e. Six (6) color caps of each color.

f. Twenty (20) indicating lamps.

g. One (1) reversing starter of each size.

h. One (1) overload relay of each size.

3. Supplies:

a. Where oil lubricated equipment is used, sufficient oil, of types approved by the equipment manufacturer, shall be supplied for one (1) year of operation.

b. For grease lubricated bearings sufficient grease shall be supplied for one (1) year of operation.

c. For explosion-proof enclosures with desiccant-type dehumidification, provide a 2-year supply of desiccant. Include instructions for renewal of the desiccant supply.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stainless Steel Slide Gates:

1. Hydrogate, Denver, CO;

2. Waterman, Exeter, CA

3. Rontaine-Aquanox,, QC;

4. Whipps, Inc. Athol, MA;

5. Or approved equal.

B. Electric Motor Operators:

1. Limitorque Corp., Lynchburg, VA;

2. Rotork Control, Inc., Mullica Hill, NJ;

3.

4. AUMA Actuators, Inc., Canonsburg, PA;

5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Fabricated stainless steel slide gates shall meet or exceed the requirements of AWWA C561.

2. The working design stresses on the disc and frame, under maximum load conditions, shall not exceed the lesser of the following:

a. 40% of the yield strength of the materials; or

b. 25% of the ultimate strength of the materials.

B. Slide:

1. General:

a. Design slide gate slides to limit deflection under maximum loading as specified in Schedule 40 05 59.05-1, located after the "End of Section" designation, to the lesser of the following two (2) values:

1) $^{1}/_{720}$ of the span of the gate; or

2) 0.25-in.

b. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of ¼-inch.

c. The slide shall not deflect more than 1/720 of the span or 1/16 inch, whichever is smaller under the maximum design head.

d. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 80 square feet, the portion of the slide member that engages the guide shall be ½-inch thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 120 square feet, the portion of the slide that engages the guide members shall be of a “thick edge” design. The thick edge portion of the slide shall have a minimum thickness of 2.5 inches.

e. Reinforcing stiffeners shall be welded to the slide and mounted horizontally. Vertical stiffeners shall be welded on the outside of the horizontal stiffeners for additional reinforcement. When required to maintain proper plate stress and deflection intermediate vertical gussets shall be provided. Approximate safety factors shall be applied to the ultimate tensile and yield strength of the material.

f. The stem connector shall be constructed of two angles or plates. The stem connector shall be welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

C. Frame:

1. General:

   a. The structural portion of the frame that incorporates the seat / seals shall be formed into a one-piece shape for rigidity. Guide members that consist of two or more bolted structural members are not acceptable. Guide member designs where water loads are transferred through the assembly bolts are specifically not acceptable.

   b. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts, or the wall thimble studs.

   c. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.

   d.

2. Materials:

   a. Frame and guides: Type 316L stainless steel meeting the requirements of ASTM A276.

D. Invert:

1. Shall be a stainless-steel angle welded to the bottom of the guides to form the seating surface for the flush-bottom seals attached to the frame invert.

E. Yoke:

1. General:

   a. Provide a yoke for all slide gates.

   b. Design shall allow removal of the slide without removal of the yoke.

   c. The yoke shall be designed so that the deflection under full operating load shall not exceed whichever is less of the following two values:

      1) $^{1}/_{720}$ the width of the gate; or

      2) 0.25-in.

   a. Materials and Construction: Yoke shall consist of two (2) structural formed channel members welded to the top of the guides.

   b. Type 316L stainless steel meeting the requirements of ASTM A276.

F. Seals:

1. General:

a. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.

b. All gates shall be equipped with Ultra-High Molecular Weight (UHMW) Polyethylene seat and seals to restrict leakage and to prevent metal to metal contact between the frame and slide. Seat contact pressure shall not exceed 600 psig at the design head.

c. The seat/seals shall extend to accommodate 1.5 times the height of the slide when the slide is in the fully closed or fully opened position.

d. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with Type 316 stainless steel attachment hardware.

e. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

f. All seals must be bolted or otherwise mechanically fastened to the frame or slide.

1) Arrangements with seals that are force fit or held in place with adhesives are not acceptable.

g. The seals shall be mounted so as not to obstruct the water way opening.

h. Gates that utilize rubber ”J” seals or ”P” seals are not acceptable.

i. The seal system shall have been factory tested to confirm negligible wear (less than 0.01-in.) and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

2. Materials and Construction of Seals:

a. Ultra-High Molecular Weight Polyethylene ASTM D4020 and/or Neoprene ASTM D2000 Grade AA625.

G. Slide Gate Operators and Lifting Stems:

1. General:

a. Provide slide gate operators and lifting stems.

b. Provide all slide gates with rising stems, as specified in Schedule 40 05 59.05, located after the "End of Section" designation, or as shown on Contract Drawings.

c. The stem diameter shall be based on the following modified Euler's equation (Using the AWWA equation to calculate the stem diameter will not be approved.):

$$\frac{P}{a} = \frac{571{,}000{,}000}{\left(L/R\right)^2}$$

where:
P = The maximum force applied to stem, resulting from manual or power operation (lbf)
a = Cross sectional area of stem, at root of thread, if any (in^2).
L = Unrestrained length (in.)
R = Radius of gyration.

1) The value of P/a shall not exceed two thirds of the yield stress of the stem material.

2) To determine stem diameters, force P shall be set to the following values:

a) For electrical operators: Force P shall be based on twice the stalled (locked) rotor force.

b) For manual operation: Force P shall be based on a manual force of 250 lbf applied to the operating handwheel.

d. Stem shall be constructed of solid stainless steel bar for the entire length and the metal shall have a tensile strength of not less than 75,000 psi. Stem extension pipes are not acceptable. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 63-microinch finish or better. Stub threads are not acceptable.

2. Materials and Construction:

a. Design stems for the maximum operating torque of the operator and the weight and service of the gate.

b. Limit the length over radius of gyration ratio of the stem to 200.

c. The minimum stem diameter shall be 2.00-in.

d. Bronze components shall conform to the requirements of ASTM B98.

e. Stainless steel components shall be ASTM A276 Type 316.

f. Slide Gate Operators:

1) Operator housings and pedestal handwheels:

a) Ductile iron:

(1) ASTM A395

(2) A536, Grade 65-45-12

2) Operator worms, steel: ASTM A29/A 29M Grade Designation 8620

3) Operator gears, steel: ASTM A572/A572M

4) Worm gears, bronze:

a) ASTM B148, Alloy UNS No. C95400/C95500

b) ASTM B584, Alloy UNS No. C86300

5) Lift Nut: Manganese bronze, ASTM B584, Alloy UNS No. C86500

6) Pinion Shaft: Stainless steel, ASTM A276, Type 316

7) Floorstand Support Brackets:

a)

b) Fabricated Stainless Steel, ASTM A167, Type 316.

8) Stem:

a) Stainless Steel, ASTM 276 Type 316.

9) Stem Protection, Bottom:

a) Stainless steel, ASTM A240/A 240M, Type 304, Schedule 20 pipe (minimum).

10) Stem Cover, Top:

a) Clear polycarbonate, ASTM D3935, ASTM D707; or

b) Cast methacrylate plastic, ASTM D5436, Clear plastic butyrate pipe.

3. Appurtenances:

a. Support:

1) Provide an operator supporting structure capable of supporting the operator and all appurtenances. The maximum deflection of the operator supporting structure shall not exceed the lesser of the following under full

operating load, when a 40-lbf. effort is placed on the handwheel :

a) $^{1}/_{720}$ of the span of the gate; or

b) 0.25-in.

2) Design the structure with a factor of safety of 5 based on the ultimate tensile, compressive, and shear strength of the material.

b. Handwheel :

1) Mount manually operated handwheels directly on the lifting mechanism to maximum height of 3.5 above the operating grating.

2) Where the lifting mechanism is above this elevation, mount the handwheel on the side of the head frame.

3) Connect side-mounted wheel operators to the lifting mechanism with bronze or cadmium-plated gearing and stainless steel shafting supported on roller bearing mounts. Limit operator to a maximum pull of 40 lbf. on the handwheel at design load.

c. Rising Stems:

1) Provide rising stem operators.

2) Securely fasten stems to the gate by means of a casting, mounting block or angles secured to the gate.

3) Acme-threaded stem to have 16 micro-inch finish or better.

4) Gate stem attachment to be provided with provisions for keying two bolt stem connector or pinning the stem to the gate attachment.

d. Stem Guides:

1) Provide stem guides where required to limit the unsupported stem length

2) Stem guide brackets shall be fabricated stainless steel Type 316L.

e. Stem Covers:

1) The stem cover shall have a rain cap, vent holes to prevent condensation and clear biaxially-oriented polyethylene terephthalate travel indicating tape.

a) Travel indicating tape shall have markings in increments of every one inch.

2) The tape shall be field applied to the stem cover after the gate has been installed and positioned.

3) Stem covers shall be as shown in Contract Drawing.

f. Wall Thimbles:

1) General

a) Provide wall thimbles as shown in the Contract Drawings.

2) Materials of Construction

a) A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be design to allow thorough and uniform concrete placement during installation.

b) Type 316 stainless steel.

(1) Minimum ¼ inch thickness.

3) Compatible stainless steel type F wall thimble with a depth of 12-in. shall be installed for each slide gate

H. Floor Boxes:

1. Provide stainless steel, floodproof, floor box with 2-inch operating nut in the roadway for operation of the gate stem extension. Floor box shall be Trumbull Manufacturing Inc., item 367-4621 or equal.

2. Provide floor box with Buna N O-ring, tamper resistant fasteners, brass bushing, and position indicator.

3. Provide threaded 2-1/2-inch diameter, schedule 40, stainless steel pipe with welded and gusseted base mounting flange to enclose the gate stem extension between roof of the wet well and the floor box.

4. Joint between the base flange and the wet well roof slab shall be floodproof.

I. Portable Operator:

1. Provide portable operators of the electric drill type with a reversing switch and safety hold-down ON-OFF switch incorporated in the handle.

2. Provide a heavy-duty electric drill that drives through an overload release clutch of the positive, spring loaded, hand type which instantly releases at a preset torque.

3. Provide adaptors to fit the pinion shafts on the floor stands and other operators.

4. Furnish a heavy-duty cord at least 60-ft long (from Mezzanine level out to the floor boxes) with an explosion-proof plug that is compatible with the

convenience outlets. Mount the unit on a tripod which has an adjustable height.

5. Provide a unit that operates using 120 V, 60 Hz current. Provide equipment rated for the area classification of the gate.

J. Electric Operators (Open/Close)

1. General:

a. Electric operators for open/close service shall conform to the requirements of AWWA C542.

b. Provide operators that hold the gate in any position from fully open to fully closed, without vibration.

c. Application Criteria:

1) Temperature Range: -20°F to +140°F.

2) Ambient Humidity: 100%.

3) Maximum design seating and unseating heads:

a) Refer to Schedule 40 05 59.05-1, located after the "End of Section" designation.

4) Opening and closing speeds: 12-in./min

a) Shall be for both open and close directions.

b) Speed hall be when the differential pressure is the maximum specified and the voltage at the terminals is 15% below the nominal voltage.

5) Power Supply: 480 V, 3-phase, 60-Hz.

6) Control voltage: 120 V, single phase, 60-Hz.

7) Integral Transformer:

a) Provide an integral 480V/120V control transformer with fused secondary.

8) Torque:

a) Design the operator to exert an unseating torque of ≥ 50% in excess of the required slide seating torque at the specified voltage, neglecting hammer-blow effect.

9) Duty Cycle:

a) Provide a motor rated for 15 min. cycle or three (3) complete cycles opening and closing gate, whichever is longer, during a 60-minute period.

b) Duty cycle shall be measured under maximum operating head, as specified in Schedule 40 05 59.05-1, located after the "End of Section" designation, and at 40° C ambient temperature.

10) Each gate operator shall be equipped with a hand wheel for manual operation:

a) Rim pull: ≤ 40 lbf.

b) The handwheel shall be connected such that operation by the motor will not cause the handwheel to operate.

c) Provide an operator that is arranged so that motor or motor gearing failure does not prevent manual operation.

d) Arrange the operator to automatically change from manual operation to electrical operation when its motor is energized and to continue electric operation until the operator is reset to manual operation.

e) Provide a means for locking the drive in either manual or motor operation.

f) Handwheel shall be removable.

11) The operator shall be operable with handwheel even after the electric motor has been disengaged and removed for repairs.

d. All electrical shall conform to the area classification shown on the Contract Drawings and conform to the area classification specified in Schedule 40 05 59.05-1, located after the "End of Section" designation.

2. Materials and Construction:

a. Electric Motor:

1) General:

a) Motor shall be in accordance with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

b) Motor shall be specifically designed for gate operator service.

c) Motor shall have high torque characteristics.

d) Motor shall have a maximum continuous total temperature rating of 70° C.

e) The motor shall be sized for at least 1.5 times the operator torque requirement.

b. Operator Mounting:

1) Design the operator to be mounted on the floor stand, unless otherwise shown or specified.

c. Power Gearing:

1) Provide power gearing consisting of:

a) Worm gear; and

b) One (1) of the following two (2) gear types:

(1) Helical gear; or

(2) Spur gears.

2) Worm Gear:

a) Shall be of either:

(1) hardened alloy steel with threads ground and polished after heat treating; or

(2) Nickel or manganese bronze.

3) Helical and spur gears:

a) Shall be of accurately machined hardened alloy steel.

4) Use antifriction bearings throughout.

5) Provide grease pack or oil bath lubrication.

d. Lost-Motion Device:

1) Provide a lost-motion device that will permit the motor to attain full speed, and then impart a hammer blow to the stem nut to start movement of the slide in both the opening and closing directions.

e. Declutching Mechanism:

1) Provide a declutching mechanism to disengage the motor mechanically but not electrically from motor to handwheel operation.

2) If the clutch is of the external lever type, arrange it such that the lever does not move when the motor is energized.

f. Position Indication:

1) Provide an operator-mounted gate position indicator of either:

a) The mechanical; or

b) The indicating light type.

2) Indicate the following:

a) Fully open position; and

b) Fully closed position; and

c) Intermediate gate position.

3) Provide electrical contacts as required for remote indication of gate position.

g. Housing:

1) Provide housings for controls, gears, and motors with integrally cast flanges.

2) Fully machine and template drill the flanges and their mating surfaces.

3) Provide joints which are metal-to-metal or gasket or O-ring sealed as required.

h. Control and Motor Enclosures:

1) Provide the controller with mechanical interlocks and mount as an integral part of the operator.

2) For explosion-proof enclosures which are dependent upon metal-to-metal faces for weatherproofing, either:

a) Provide explosion-proof breathers and drains with desiccant type dehumidification.

(1) Desiccant shall be silica gel and enclosure shall have sufficient desiccant capacity for 6 mo. service without requiring renewal.

b) Provide actuators that are hermitically sealed which do not require breathers and drains or desiccant.

i. Electrical Compartment Heater:

1) Provide electrical compartment heaters.

j. Reversing Controller, Overload Protection and Internal Wiring:

1) Provide a reversing controller, complete with mechanical interlocks and controls as an integral part of the operator.

2) Provide adequate overload protection in the controller or embedded in the motor windings.

3) Install an overload device in each phase.

4) If overload devices are installed in the motor windings, provide devices of the bimetallic automatic reset type with the contacts in the control circuit.

5) Arrange the internal wiring in the operator so that the opening and closing coils cannot be energized simultaneously at any time, regardless of external wiring conditions.

k. Push Buttons and Selector Switches:

1) Where operators are 6 feet or closer to the floor and in an accessible location, mount OPEN-STOP-CLOSE push buttons or a selector switch.

2) Where the operators are located over 6 feet from the floor or in an inaccessible location, connect all internal control and indication wiring to a terminal block within the operator enclosure and provide a separate control station for remote mounting. Provide the remote control station with the same NEMA rating as the operator.

l. Limit and Torque Switches:

1) Provide the operator with limit and torque switches, either direct or gear driven.

2) Provide adjustable limit and torque switches with auxiliary contacts that are operative in either direction of travel.

3) Provide limit switches that are "in step" with torque switches at all times, whether in motor or manual operation.

4) Equip the operator with limit switches to stop movement in each direction and torque switches for protection against mechanical overload and to stop movement in either direction if an obstruction is encountered.

5) Provide the number, function and arrangement of limit switches as shown, specified or required.

3. Appurtenances:

a. Operator Mounting:

1) All mounting brackets, structural supports and other accessories necessary for a complete installation of each actuator, control enclosure and push-button station shall be supplied by the actuator manufacturer.

2) The mounting bracket shall be fabricated of Type 316 stainless steel.

3) All welding shall be a continuous Type 316 stainless steel weld on both sides of the plates and shall have predrilled holes to match the holes on the base.

4) The brackets shall be secured to the base with Type 316 stainless steel through bolts, double nuts and oversized washers (two double nuts and two washers per bolt assembly).

5) All fasteners and hardware shall be stainless steel ASTM A276, Type 316 and ASTM A320, B8 or B8F.

b. Electrical Connections:

1) All field connections shall be made to a factory-installed external NEMA 7 terminal box suitable for accepting the conduit and conductor connections.

4. Controls:

a. Provide each operator with controls:

1) Electrical controls shall include all necessary disconnect switches, motor starter and circuit breakers plus control power transformer to provide a complete system requiring only a single input power connection.

2) A panel-mounted disconnect switch shall be provided.

a) The door of the enclosure shall be mechanically interlocked with the disconnect switch such that the door cannot be opened with the switch in the ON position without using a tool-operated defeater.

3) Each motor circuit shall be protected with:

a) A properly sized, adjustable, magnetically-tripped, three-pole motor circuit protector; and

b) A motor starter with manual reset thermal overload relay.

4) All indicating lights, push buttons, and other devices shall be of the heavy-duty, full-size, oil-tight type.

a) They shall be NEMA rated in conformance with the requirements pertaining to the location of the control as shown on the Contract Drawings or specified herein.

5) Each door-mounted device shall have its own lamicoid plastic legend plate custom engraved by the actuator manufacturer.

6) A means shall be provided to test all indicating lights either using Push-to-Test lights or via a single Lamp Test push button.

a) Testing of lights shall not interrupt or affect the control functions.

7) Each actuator shall also be equipped with a safeguard to shut off the actuator on failure of essential electrical or hydraulic components and shall be set for plus 25% of the normal operating time.

b. Control Circuits:

1) All ladder-logical controls shall be performed through the use of either relays and timers, or a programmable logic controller (PLC).

2) When a PLC is provided for logical control, a programming unit shall be provided with the controller for adjusting and revising timer and counter constants. It shall be possible to modify and monitor the control program using the programming unit. A means shall be available for back-up downloading and recovering the program.

3) Spare PLC inputs and outputs shall be provided and factory wired to terminals. The minimum number of spares shall be ten percent of each of the total inputs and outputs, but in no case shall there be less than three spare inputs and three spare outputs.

4) The PLC shall be supplied with two user's manuals which shall be shipped in the power unit control panel.

5) The actuator manufacturer shall be responsible for the programming of the PLC to accomplish all required control functions.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Seat/Seal:

1. All sealing surfaces shall be Type 316L stainless steel.

B. Seals:

1. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements specified herein.

2. The gate leakage shall not exceed the following rates, when subjected to the design seating and unseating hydrostatic heads specified in Schedule 40 05 59.05-1, located after the “End of Section” designation:

a. For seating head conditions: $\leq$ 0.1 gpm/ft of seating perimeter.

b. For unseating head conditions (up to a maximum head as of 20 ft, measured for the purpose of this calculation from the gate invert): $\leq$ 0.1 gpm/ft of seating perimeter.

C. Operator:

1. Lifting Stem:

a. Provide thread contact surfaces with a minimum 63×10^{-6}-in. finish.

2. Mounting:

a. Mount operators on a structural yoke.

D. Anchorage Devices:

1. Provide anchorage devices in accordance with Section 05 05 23.02 - Miscellaneous Metal Fastenings.

E. Identification:

1. Provide in accordance with Section 40 05 97 - Identification for Process Equipment.

F. Shop Painting:

1. Coat machined, polished, and non-ferrous metal surfaces and similar un-painted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

2. Stainless Steel: Do not paint stainless steel.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop tests shall be performed and certified at the factory for all stainless steel hydraulic gates in accordance with the requirements of the Contract Documents.

B. All slide gates shall be shop tested for leakage at the seating and unseating hydrostatic heads specified in Schedule 40 05 59.05-1, located after the "End of Section" designation.

C. Witnessing of shop tests:

1. Shop tests for the stainless steel hydraulic slide gates shall be witnessed in accordance with the requirements of the Contract Documents.

2. Quantity of shop tests that shall be witnessed:

a. Refer to Schedule 40 05 59.05-1, located after the “End of Section” Designation.

b. All shop test as described above shall be witnessed in accordance with Section 01 43 15 – Witness Shop Testing. The Contractor shall note that submission of the shop test results and written notification by the Engineer of acceptance of the results is necessary before equipment can be shipped to the Site.

1) Gates that exceed the specified leakage rates shall be rejected.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. The existing thimbles shall be removed, and new Type 316 wall thimbles shall be installed prior to the installation of new frame.

3.02 INSTALLATION

A. Install equipment in complete accordance with the manufacturer's printed instructions and the approved shop drawings.

B. Floor and Bench Stands:

1. Accurately center floor and bench stands over the gate.

2. Solidly bolt stands to the floor or support structure, with through-bolts wherever possible.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract documents. In addition:

1. Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

B. Preliminary Field Test:

1. The manufacturer representative shall inspect the installation of equipment, make any necessary adjustments, and field calibrate the equipment upon completion of the installation of each actuator and gate.

C. Final Field Tests:

1. Subject all stainless steel hydraulic slide gates to a field running test under actual operating conditions as required herein and in the Contract Documents.

2. Test slide gates for leakage, strength, and opening and closing against the maximum heads practicable to obtain under operating conditions.

a. Leakage Test: Leakage not to exceed 0.05 gpm per foot (0.62 L/min per metre) of seal perimeter.

1) Conduct tests at design heads shown in the slide gate schedule.

b. Adjust and repair the seating and sealing surfaces as necessary to stop any noticeable leaks around the frames or gates.

c. Provide an installation for which the amount of seepage through any slide gate does not exceed the maximum allowable amounts specified herein for the seating and unseating conditions specified

in Schedule 40 05 59.05-1, located after the "End of Section" designation.

3. Slide Gates and Operators:

   a. Field test all slide gates and operators by having each operator open and close the gate through the full range of travel at least four times.

      1) The field tests shall demonstrate that all equipment, controls and monitoring operate as specified and within the allowable leakage rates.

   b. Field test all gates with associated operators.

      1) For electro-operated gate, field test the gate separately from each local control panel, remote control panel or push-button station.

      2) Field test the manual overrides for electro-operators to demonstrate that they can seat and unseat each gate by operating the gate through a travel of at least 12 inches.

4. Test slide gates for leakage, strength, and opening and closing against the maximum heads specified in in Schedule 40 05 59.05-1, located after the "End of Section" designation, unless otherwise approved by the Engineer.

5. Each slide gate shall be operated through all modes of operation.

6. Repair any leaks around the frames and adjust the gate seals as necessary to reduce leakage to within allowable limits.

   a. Leakage around slides shall not exceed the maximum amount specified herein.

D. At a minimum, the services of the manufacturer's representative shall be provided as indicated below. The number of visits and person-days per visit, indicated below refers to the total required services for the slide gates provided under this Section.

Visit:	Purpose:	No. of Visits:	Person-days per visit:
1	Installation Checkout	1	2
2	Field Testing	1	2

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist in the start-up of the equipment and train the plant operations and maintenance staff in the care, operation, and maintenance of the equipment in accordance with the requirements of the Contract Documents. In addition:

1. Contractor shall make all adjustments required to place all Work in proper operating condition.
2. Contractor shall include in training of plant personnel instruction on care and maintenance of the materials and equipment.
3. In the event of trouble with the equipment during startup / initial operation, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

B. At a minimum, the services of the manufacturer's representative shall be provided as indicated below. The number of visits and person-days per visit indicated below refers to the total required services for the slide gates provided under this Section.

Visit:	Purpose:	No. of Visits:	Person-days per visit:
3	Startup / Initial Operation	1	2
4	Training	1	2

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting of scratched or damaged surfaces, using primer, intermediate and finish paints provided by the manufacturer, in accordance with the requirements of Section 09 91 00 - Painting.

END OF SECTION

SCHEDULE 40 05 59.05-1
STAINLESS STEEL SLIDE GATE SCHEDULE

Name:	Ralph Avenue Influent Sluidce Gate	Avenue M Influent Gate
Type:	[Type of Gate]Slide Gate	[Type of Gate]Slide Gate
Quantity:	##1	##1
Seal:	Flush [top/bottom]	Flush [top/bottom]
Size (W × H):	##-148-in. × ##-148-in.	##-3048-in. × ##-3048-in.
Design Seating Head:	## 2710 ft	## 2710 ft
Design Unseating Head:	## 2710 ft	## 2170 ft
Operating Head:	#.## 463 ft	#.## 64.884 ft
Operator:	[Geared Floorstand Handcrank, Gear / Portable Operator Compatible / Electric Motor Actuator / etc.]	[Geared Floorstand Handcrank / Portable Operator Compatible. / Electric Motor Actuator / etc.]
Area Classification:	NEMA # / N/A7	NEMA # / N/A7
Power:	480 V, 3 Ø, 60 Hz / N/A	480 V, 3 Ø, 60 Hz / N/A
Stem:	Rising	Rising
Minimum Quantity of Gates that shall be Witness Shop Tested:	25% (1 out of every 4), randomly selected by the Engineer.Yes	25% (1 out of every 4), randomly selected by the Engineer.
Tag Numbers:	1301-418-0151	###### ######

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SECTION 40 05 59.16 01 – STOP LOGS (TYPE 316L STAINLESS STEEL)
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required, to furnish and install Type 316L stainless steel stop log planks, guides, and stop log plank pullers, with all appurtenances and accessories, complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	6
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	7
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	8

C. The following schedule, attached after the end of section designation, is a part of this Section:

1. Schedule 40 05 59.16 01-1, Stop Logs (Type 316L Stainless Steel) Schedule.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 56 00.01 – Miscellaneous Metal Castings.

1.04 REFERENCES

A. Reference Standards:

1.	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2.	ASTM A276	Stainless and Heat Resisting Steel Bars and Shapes.
3.	ASTM D2000	Classification System for Rubber Products in Automotive Applications.
4.	ASTM D4020	Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
5.	AWS D1.6	Structural Welding Code – Stainless Steel

1.05 DESCRIPTION

A. The Type 316L stainless steel stop log planks shall be designed for flow in either direction and seals shall be provided for this condition.

1.06 QUALITY ASSURANCE

A. Not Used

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited, to:

1. Action Submittals:

a. Detailed dimensional drawings.

b. Assembly and installation drawings.

c. Location and details of stop log plank storage facilities.

d. Records of Operational Tests and Load Tests.

e. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

f. Data for stop log characteristics and performance.

g. Complete description of all materials, material thicknesses of all components.

h. Maximum bending stress and deflection of the stop logs under design head specified and indicated.

i. Installation drawings showing the details required for installation, dimensions, clearances and anchor bolt locations.

j. Recommended storage racks with dimensions and layout.

k. Shop drawing data for accessory items.

l. Certified setting plans, with tolerances, for anchor bolts.

m. Manufacturer's literature as needed to supplement certified data.

n. Operating and maintenance instructions and parts lists.

o. Shop and field inspection reports.

p. Qualifications of field service engineer.

q. Recommendations for short and long-term storage.

r. Field testing procedures and set up

s. Special tools.

t. The latest ISO 9001 series certification or quality system plan.

B. A copy of the contract mechanical process and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. 1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

3. Information Submittals:

a. Material certification and specifications.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

C. The equipment supplier shall coordinate delivery of the equipment with the Contractor. The equipment supplier shall promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged.

D. Notify the Contractor verbally, and in writing, of any problems.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. One set of all special tools is required.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Whipps.

B. Fontaine Aquanox.

C. Rodney Hunt.

D. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Materials:

1. Stop Logs: ASTM A240 Type 316L stainless steel.

2. Frame Guides and Invert: ASTM A240 Type 316L stainless steel

3. Fasteners, anchor bolts and miscellaneous hardware and lifting devices shall be of Type 316 stainless steel conforming to ASTM A276.

   a. Anchor Bolts: Minimum 1/2-inch diameter

4. All component parts shall be protected from dissimilar metals.

5. Lip-type seals shall be extruded neoprene conforming to ASTM D2000, Grade 2BC515, Durometer 50 ± 5.

B. Details of Construction:

1. Provide all stop logs produced by a single manufacturer and designed for installation in the channels and structures as specified and indicated.

2. Stop log Configuration, Dimensions and Characteristics: As indicated in the Stop Log Schedule.

3. Provide the stop logs with a continuous resilient seal along the bottom and both sides. Seals on or within the guide frames are not acceptable.

4. Stop Log Height: As indicated and designed to function as specified and indicated when stacked in any order.

5. Provide all structural components of the stop logs fabricated of stainless steel and with strength to prevent distortion during normal handling, during installation and while in service as specified and indicated.

6. Provide all structural components of the guide frames fabricated of stainless steel with strength to prevent distortion during normal handling, during installation and while in service as specified and indicated.

7. Provide all welds performed by welders with AWS D1.6 or ASME Section IX certification for stainless steel.

8. Finish: Mill finish on stainless steel.

    a. Provide weld on stainless steel passivated in accordance with ASTM A380 to remove weld burn and scale.

9. Maximum Bending Stress: Not to exceed 18,000 psi for stainless steel at

the maximum operating head specified in Schedule 40 05 59.16 01-1, Stop Logs (Type 316L Stainless Steel) Schedule, located after the "End of Section" designation of this Section.

10. Two lifting lugs shall be provided for each stop log plank. Lifting lugs shall be capable of withstanding the lifting load necessary to remove the stop log plank under the field design head.

11. Lip-type Seals:

    a. Provide stop logs with a continuous resilient seal along the bottom and both sides to restrict the leakage to the rate specified.

    b. Provide all seals of urethane or rubber, replaceable and mechanically retained to the stop logs.

    c. Stop logs using rubber “J” or “P” seals are not acceptable.

    d. Maximum guaranteed leakage: 0.05 gpm/ft of wetted seal perimeter.

12. Guides:

    a. The guides for the stop log planks shall be either surface mounted or embedded in the concrete with stainless steel anchor bolts and grout.

    b. Guides shall conform to the requirements of Section 05 56 00.01 – Miscellaneous Metal Castings.

    c. Guides and all necessary attaching bolts and anchor bolts shall be furnished by the stop log plank manufacturer.

    d. Provide frame guides or grooves and invert members constructed of stainless steel plate with a minimum thickness of 1/4-inch.

    e. Provide a flush bottom invert member across the bottom of the guides.

    f. Frame mounted seals are not acceptable.

13. Lifting Device:

    a. Provide one (1) stop log lifter for each different stop log (guide frame) width.

    b. Provide the lifter constructed of Type 304L stainless steel and fitted with UHMW guide bars and stainless steel fasteners. Aluminum is not acceptable.

    c. Provide the lifter with lifting hooks designed to engage the slots in the top of the stop logs.

    d. Lifting device shall be provided to remove and install the stop log plank as specified herein. The lifters shall be extendible so that they will function with different stop log plank lengths.

    e. The lifting device shall be equipped with a suitable eye bolt for portable crane operation. The device shall be oriented in its position by the stop log plank guides and shall be capable of securing and releasing the stop logs with the use of a lanyard from the operating floor.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Stop Log Plank Storage:

1. The Contractor shall fabricate and install brackets, chains, angles, etc., on handrail or exterior walls, near the stop log plank installation locations for storage of the planks.

2. Provide storage racks constructed of Type 304L stainless steel. Storage racks are to constructed to be liftable and movable by crane and forklift. Stop log manufacturer must provide a recommended layout and rack dimension for each location specified and indicated.

3. Storage brackets and stop log planks shall not overstress the structure to which they are attached for storage.

4. Location and details of storage facilities shall be submitted to the Engineer for approval prior to installation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. The lifting devices shall comply with the marking requirements listed in ASME B30.20-1.2.1 Marking.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examination of Stop Log Plank Locations:

1. Contractor shall examine the locations of the stop log planks to verify all pertinent dimensions prior to fabrication of the stop log planks.

2. Contractor shall have full responsibility for the proper fit of the furnished stop log planks at the locations designated on the Contract Drawings.

3.02 INSTALLATION

A. Number, size and location of stop log planks, guides and lifting devices shall be provided as shown on the Contract Drawings or called for in the Contract Documents.

B. The completely assembled stop log planks shall be tested for the manufacturer's guaranteed leakage criteria.

C. Install items in accordance with shop drawings, manufacturer's printed instructions and as indicated.

D. Clean debris, dirt, and gravel, from inside of stop logs, guide frames and channels before placing stop logs.

E. Install guide frames in a true vertical position and grout all voids between guide frames and walls.

F. Inspect material for defects in workmanship and material.

3.03 FIELD TESTING / QUALITY CONTROL

A. After installation of guide frames, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s field service technician, conduct operating and leakage test for each stop log in presence of the Engineer to determine its ability to operate as specified, and to operate without jamming under specified conditions.

B. Leakage Test: Leakage not to exceed 0.05 gpm per foot of seal perimeter.

C. Test installation and removal of each stop log location with the number of stops logs as indicated.

D. Conduct tests at design heads indicated in the Stop Log Schedule.

E. Contractor shall demonstrate, using a stop log puller and lifting device, the ease of installation, removal and the proper fit of the stop log planks at their locations of use in the presence of and to the satisfaction of the Engineer.

F. Any stop log planks that bind, do not fit, or do not meet leakage requirements shall be repaired and retested all at no additional cost to the City.

G. Testing of Lifting Devices: Operational test in accordance with the requirements of ASME 30.20-1.3.8.2 Operational Test.

H. Load test in accordance with the requirements of ASME B30.20-1.3.8.2 Load Test.

I. Contractor to provide all water labor, piping, testing equipment for conducting tests.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SCHEDULE 40 05 59.16 01-1
STOP LOGS (316L STAINLESS STEEL) SCHEDULE

Location:	Chan. Dimensions		Invert Elevation:	Design Head:	Water Surface Elevations:			
	Width	Height			Upstream Side:		Downstream Side:	
	(in.)	(in.)	(ft)	(ft)	Min. (ft)	Max. (ft)	Min. (ft)	Max. (ft)
Interim Pump Station	96	90	-13.0	25.0	-13.0	12.0	-13.0	12.0
Avenue M Influent Channel	84	48	-15.50	27.50	-15.50	12.0	-15.0	12.0

NO TEXT ON THIS PAGE

SECTION 40 05 96 – VIBRATION AND SEISMIC CONTROLS FOR PROCESS EQUIPMENT
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required to furnish, install, and test all vibration control devices, complete and operational.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	7
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	8
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Not Used

1.04 REFERENCES

A. Not Used

1.05 DESCRIPTION

A. This Section includes requirements for providing vibration and seismic controls for process equipment in accordance with applicable standards and regulations.

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturers:

1. The manufacturer(s) shall have a minimum of five (5) years of experience in the manufacture of process piping insulation products of similar size and type to those specified herein, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

B. Supply and Compatibility:

1. All components of vibration and seismic controls for process equipment shall be provided by the Contractor through a single vibration and seismic controls vendor.

a. The Contractor (through the vibration and seismic controls vendor) shall have the sole responsibility for matching all components and providing equipment which functions together as a system.

2. The vibration and seismic controls for process equipment shall be standard products of the manufacturer.

3. The vibration and seismic controls for process equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.

4. Qualifications of Vendor:

a. Vendor shall have at least five (5) years of experience in the design and fabrication of the vibration and seismic controls for process equipment of similar size, capacity, and type to those specified herein, and shall show evidence of at least five (5) substantially similar installations in satisfactory operation.

C. Regulatory Requirements:

1. All Work shall conform to any and all applicable requirements of ASHRAE, OSHA, and AMCA pertaining to limitations of sound and vibration levels.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition:

1. Action Submittals

a. Contractor shall submit Shop Drawings and material specifications for the approval of the Engineer. Submittals shall include, but not be limited, to:

1) Manufacturer's literature, illustrations, Specification and engineering data showing the following:
   a) Isolation mounting deflections.
   b) Spring diameters.
   c) Compressed spring height at rated load.
   d) Solid spring height.
   e) Equipment operating speed.
   f) Tabulated data for equipment weights and vibration eliminator capacities.
2) Other technical data related to the specified equipment.

2. Information Submittals:
   a. Manufacturer instructions for handling, storing, installing, and adjusting of products.
   b. Qualifications of vibration and seismic controls vendor.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver equipment and materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store equipment and materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide vibration isolation and seismic control equipment (except for flexible connections at pumps) as manufactured by:
   1. Mason Industries, Hauppauge, NY;
   2. Vibration Eliminator Co., Copiague, NY;
   3. Or approved equal.

B. Provide flexible connectors at pumps as manufactured by:

1. Flexonics Products
2. U.S. Bellows
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Design Criteria:

1. All Work shall operate under all conditions of load without objectionable sound or vibration.
2. Vibration control shall be achieved by use of approved vibration eliminators installed as directed by the manufacturer of the eliminators.
    a. Vibration isolators shall be selected for uniform state deflections according to distribution of weight.
    b. Selections shall be based on lowest rotational speed as disturbing frequency.
    c. Total rated capacity of isolators shall be at least 110 percent of the weight of equipment supported. Contractor to verify the actual weight of the equipment to be supported.
    d. Housings, fabricated steel parts, hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to provide a complete vibration isolation system as described below and shall be Type 316 stainless steel construction.

B. Spring Hangers:

1. Type: Spring isolators, laterally unrestrained.
2. Efficiency: 95% at rated load.
3. Construction:
    a. Designed so that ratio of horizontal to vertical spring constants is between one and two.
    b. Spring with 0.3-in. deflection EPDM element.
    c. EPDM element shall have rod isolation bushing.
    d. Hanger shall permit rod to swing through 30-degree arc before contacting metal.
    e. Spring shall have additional travel to solid of 50% of rated deflection.

C. Housed (Restrained) Spring Mountings:

1. Type: Spring isolator, free standing, laterally stable with housing.
2. Efficiency: 95% at rated load.

3. Construction:
    a. Housing: Shall include vertical limit stops.
    b. Clearance: Maintain ½-in. clearance around restraining bolts and between housing and spring.
    c. Weatherproofing: Type 316 stainless steel housing cover for outdoor use.
    d. Baseplate with ¼-in. acoustical friction pad between baseplate and support.
    e. Leveling bolts rigidly bolted to the equipment.
    f. Spring diameter 0.8 of the compressed spring height at rated load.
    g. Minimum spring deflection before becoming solid shall be at least 50% greater than the specified minimum deflection.

D. Rubber Mats:
1. Type: EPDM waffle mat.
2. Construction: Two (2) $^{5}/_{16}$-in. thick EPDM layers with a 16 ga., Type 316 stainless steel plate cemented between layers.

E. Double Deflection Rubber Mounting:
1. Double deflection neoprene mountings shall have a minimum static deflection of 0.35-in.
2. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor.
3. Bolt holes shall be provided for these areas where bolting is required.
4. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang. Mountings shall be type ND or rails type DNR.

F. Horizontal Thrust Restraints:
1. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad with the same deflection as specified for the mountings or hangers.
    a. The spring element shall be contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of ¼-in. movement at start and stop.
2. The assembly shall be furnished with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and the structure.

G. Vertical Riser Pipe Anchors

1. Provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two (2) sizes of steel tubing separated by a minimum ½-in. thickness of heavy duty neoprene and duck or neoprene isolation material.

2. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.

H. Flexible Connectors:

1. For ductwork connected to equipment with motors:

a. Flexible neoprene connectors shall be manufactured of multiple plies of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses.

b. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres.

c. End Connections for flexible connections:

1) Connectors up to and including 1½-in. diameter may have threaded ends.

2) Connectors 2-in. and larger shall be manufactured with floating Type 316 stainless steel flanges recessed to lock the connector's raised face neoprene flanges.

d. Hoses shall be installed on the equipment side of the shut-off valves.

e. Connectors shall be rated a minimum of 150 psig at 220°F.

f. Flanged equipment shall be directly connected to neoprene elbows in the size range 2½-in. through 12-in. if the piping makes at 90° turn at the equipment.

g. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure.

h. 12-in. and larger sizes operating above 100 psig shall employ control cables with end fittings isolated by means of ½-in. thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psig.

2. At Pumps:

a. Flexible connectors at base mounted hot and chilled water pumps shall consist of a stainless steel bellows assembly complete with flanged carbon steel fittings, heavy duty restraining rods and spacers.

b. The connector shall be suitable for use with water at 250°F and 125 psig or the test pressure of the pipeline, whichever is greater.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Riser Isolation: Risers shall be suspended from or supported by spring hangers or housed spring mountings and the piping anchored or guided with pipe anchors. Type 316 stainless steel. Spring piping deflections shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit deflection or load changes to plus or minus 25% of the initial stress.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. Inspect anchor bolts for proper locations.

3.02 INSTALLATION

A. Install vibration and seismic controls in complete accordance with the manufacturer's printed installation instructions and the approved shop drawings. In addition:

1. Use types of isolators for equipment specified below unless otherwise specified.

Equipment	Type
Central station air handling (heating and ventilation) units, and central station rooftop air handling units.	Internally mounted housed spring mountings for fans and motors (factory installed by unit manufacturer).
Air cooled condensers, chillers, fluid coolers, control room air conditioning units, air filtration units.	Rubber mats.
Unit heaters, centrifugal inline fans, or other suspended equipment with fans and/or motors.	Spring hangers
Base mounted Centrifugal fans, pumps.	Housed spring isolators

2. Horizontal Thrust Restraints for Air Handling Equipment:

a. Air handling equipment shall be protected against excessive displacement which might result from high air thrusts in relation to the equipment weight.

b. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit.

3. Horizontal Pipe Isolation for Mechanical Equipment:

   a. The first three (3) pipe hangers on each side in the main lines near the mechanical equipment shall be Spring Hangers as specified herein.

      1) Floor supported piping shall rest on Housed (Restrained) Spring Mountings as specified herein.

      2) Spring hangers shall be located as close to the overhead supports as practical.

4. Vertical Riser Pipe Anchors:

   a. Allowable loads on the isolation material shall not exceed 500 psig and the design shall be balanced for equal resistance in any direction. Provide all-directional anchors.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning:

1. Remove foreign objects which might bridge vibration isolators.

END OF SECTION

SECTION 40 05 97 – IDENTIFICATION FOR PROCESS EQUIPMENT
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish and install all components of the system for identification of exposed piping and equipment.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	8
PART 3	EXECUTION	8
3.01	Examination / Preparation	8
3.02	Installation	9
3.03	Field Testing / Quality Control	9
3.04	Startup / Demonstration	9
3.05	Adjusting / Protection / Cleanup	9

C. The following schedules, attached after the “End of Section” designation, are a part of this Section:

1. Schedule 40 05 97-1, Dimensions of Identification Signs and Nameplates.
2. Schedule 40 05 97-2, Table of Standard Colors.
3. Schedule 40 05 97-3, General Color Code.
4. Schedule 40 05 97-4, Pipe Identification Signs.
5. Schedule 40 05 97-5, Nameplates.
6. Schedule 40 05 97-6, Pipeline and Equipment Identification.

7. Schedule 40 05 97-7, Mixed Sludge and Digested Sludge Recirculation Pipeline and Equipment Identification.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 09 91 00 – Painting

1.04 REFERENCES

A. ANSI A13.1 Pipe Labeling Requirements

B. ASTM D523 Standard Test Method for Specular Gloss

C. ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D. ASTM D638 Standard Test Method for Tensile Properties of Plastics

E. ASTM D646 Standard Test Method for Grammage of Paper and Paperboard (Mass per Unit Area)

F. ASTM D709 Standard Specification for Laminated Thermosetting Materials

G. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

H. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

I. ASTM D5420 Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)

J. SAE AMSSTD595 Colors Used in Government Procurement.

K. New York City Local Law 30

1.05 DESCRIPTION

A. This Section describes the system for the identification of piping and equipment. This includes the placing of identification signs and direction-of-flow arrows on all visible, exposed plant piping, the placing of nameplates on plant equipment and structures, and painting in color of all equipment and pipe (except stainless steel or aluminum surfaces) as shown on the Contractor's Shop Drawings submitted under other Section(s) for equipment, piping, and valves, and as required.

B. Pipe and equipment labeling in accordance with OSHA, DEP policies, industry standards, and as specified herein.

1.06 QUALITY ASSURANCE

A. Provide the specified items from firms regularly engaged in the manufacture of identification devices of types and sizes required, with at least five (5) years' experience in manufacturing signs.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Submit samples of the lettering to be used for fiberglass reinforced plastic signs to the Engineer for approval before manufacturing begins.

1) Such samples must show the height, width and spacing of letters and numbers for any three (3) legends of ten or more letters and spaces as specified herein.

b. Submit sample direction-of-flow arrows for both sizes of pipe identification signs to the Engineer for approval before installation.

c. Submit details of the method of fastening nameplates to the Engineer.

1) Since it is impractical to detail each means of attachment in the Contract Drawings, each means of attachment shall receive approval only on its own merits – submit for approval sketches of each type of attachment proposed.

2. Information Submittals:

a. Submit certification on acid resistance to the Engineer prior to installation.

b. Submit manufacturer's guarantee and warranty, in writing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the materials provided under this Section, and as per the requirements of the Contract Documents.

B. In addition, provide the following spare parts for identification of piping and equipment:

1. For every twenty (20) pipe identification signs installed:

a. One (1) pair stainless steel mounting screws

b. One (1) pair stainless steel threaded brackets

c. One (1) pair fiber or plastic washers

d. One (1) pair stainless steel banding seals

2. One (1) set banding tools and banding accessories

3. One (1) stainless steel banding strap, approximately 1000 ft.

4. One (1) complete nameplate mounting assembly for every twenty (20) nameplates installed

5. One (1) stainless steel cable and splice for every twenty (20) valve identification tags

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mounting assembly "Steelbinder" strapping units:

1. A.J. Gerrard & Co., Lake City, FL;

2. Independent Metal Strap, Roslyn, NY;

3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Construction:

1. Construct fiberglass reinforced plastic identification signs and nameplates of 100 mils thick fiberglass reinforced plastic conforming to ASTM D709.

2. Provide fiberglass reinforced plastic process with a blemish free, low gloss surface of superior permanence and durability in the colors selected.

3. Construct all signs and nameplates in conformity with ASTM D523, D638, D646, D790, D792, and D5420.

4. Make direction-of-flow arrows for attachment to pipe identification signs from No. 16 U.S. gauge Type 304 stainless steel, the full width of the sign.

5. Chemical Resistance:

a. Provide fiberglass reinforced plastic signs resistant to abrasion, impact, corrosion, and the following acids, alkalis, salts, and solvents in accordance with ASTM D543:

1) 10% citric acid
2) 5% acetic acid
3) 3-30% sulfuric acid
4) 10% ammonium hydroxide
5) 10% sodium chloride
6) turpentine
7) mineral spirits
8) heptane
9) kerosene
10) ethyl alcohol
11) ethyl acetate
12) transformer oil
13) heavy duty detergents
14) water

B. Lettering:

1. Provide lettering made by silk screening or other permanent embedment of subsurface printed graphics in the material so as to produce a clear, legible sign.

C. Grommets and Holes:

1. Provide signs for piping and valve identification with two ⅜-in. diameter grommet-protected holes located on the long side center line, the center of the hole to be ½-in. from the edge.

2. Provide nameplates for equipment and structures with four ⅜-in. diameter grommet-protected holes, the center of the hole located ½-in. away from the edges.

3. Provide all holes with suitable brass or Type 304 stainless steel grommets.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Dimensions of Signs and Tags:

1. Provide identification signs and nameplates rectangular in shape and of the dimensions specified in Schedule 40 05 97-1, Dimensions of Identification Signs and Nameplates, located after the "End of Section" designation.

a. A dimensioned tolerance of $\pm 1/16$- in. is permissible.

B. Lettering of Signs:

1. Perform all lettering and numbering on identification signs and nameplates in block style in size and spacing to suit the size of sign, as approved by the Engineer.
2. Unless otherwise approved by the Engineer, the following limits shall apply:
    a. Limit the legend on pipe identification signs to one (1) line and to a total of 12 letters and spaces.
    b. Limit the legend on equipment nameplates to two (2) lines and a maximum of 35 letters and spaces.
3. Do not place lettering, symbols or markings containing the name of the manufacturer on the signs.
    a. The contract number and the year of the contract as given on the Contract Drawings may be placed in small lettering on the front of the sign, if approved by the Engineer.

C. Colors:

1. Provide each identification sign and nameplate in two colors and with the legend specified.
    a. Provide the backside of the sign in black or some other uniform color.
2. Code pipeline signs and equipment nameplates and finish coats of paint for pipelines and equipment in basic colors.
3. Provide brilliant colors, distinctive shades matching as closely as possible (without custom color blending) the basic colors as specified by the Munsell Color System (MN) in Schedule 40 05 97-2, Table of Standard Colors, located after the "End of Section" designation:
4. Provide identification signs for pipelines of all sizes, mechanical equipment, slide gates, and valves in the color combinations specified in Schedule 40 05 97-3, General Color Code, located after the "End of Section" designation.
5. Provide vents and drains of the same color combination as the contents of tanks and equipment vented and drained.
6. Identification signs for services not included in the Schedule 40 05 97-3 shall be black letters on a white background.

D. Legend for Pipe Identification Signs:

1. Provide identification signs, to identify the pipeline service, with the words or abbreviations in color combinations shown in Schedule 40 05 97-4, Pipe Identification Signs, located after the "End of Section" designation.
2. Number sluice gates and valves in conformity with the Basic Code as specified by the Operation and Maintenance Manual for the plant. Perform

color combinations for such lines and valves in the same color combinations as the medium serviced and as specified in Schedule 40 05 97-3.

3. In addition to the identification requirements listed above, for all gas piping at pressures above ½ psig, show the maximum pressure level within the piping as required by New York City Local Law 30.

E. Valve and Gate Identification Tags:

1. Furnish and attach identification tags to all valves, gates, and controls.

2. Provide round fiberglass reinforced plastic tags, in sizes per Schedule 40 05 97-1, made in conformity with the requirements specified herein. Provide tags with one ⅛-in. grommet protected hole at the top for fastening to the valve body using $^{1}/_{16}$-in. diameter cable and splices or pins as approved. Provide grommets, cable splices and pins of stainless steel or other approved corrosion resistant material.

3. Provide numbering code for the identification tags in conformity with the Basic Code as specified by the Operation and Maintenance Manual for the plant. Assign identification numbers subject to the approval of the Engineer and in conformity with the entire piping and equipment identification system. Provide identification code for each valve and control without duplication. Provide lettering on identification tags not less than $^{5}/_{16}$-in. high and limited to two lines. Silk-screen lettering in correct color combination; stenciled or painted numbers and lettering will not be accepted.

4. In addition to the tagging requirements listed above, provide tags at all gas valves at pressures above ½ psig with the operating pressure within the valve shown as required by New York City Local Law 30.

F. Arrows:

1. Make the arrow head with a tapered point, about 90° at the apex, extending one half of the sign width from the sign edge and one half of the sign width extending under the sign.

   a. Make point with a radius of ¼-in. for the 3½-in. wide sign and a radius of $^{3}/_{16}$-in. for the 1½ in. wide sign.

2. Finish all edges of the arrow.

3. Punch detents on the arrows to prevent twisting of the point.

4. Drill one hole in the arrow in alignment with the hole in the pipe identification sign so that both sign and arrow can be mounted with the same screw and bracket.

G. Nameplates:

1. Provide nameplates for equipment in the same color combination as the medium they service. Legends for nameplates must follow the terminology

shown. Provide numbering system as described in the Operation and Maintenance Manual.

2. Schedule 40 05 97-5, Nameplates, located after the "End of Section" designation, is a representative list (and not necessarily complete) of nameplate legends with appropriate color combinations to which the equipment identification number(s) shall be added.

H. Additional Signs and Nameplates:

1. In addition to the legends specified above, the Engineer may order the Contractor to furnish and install additional identification signs, arrows and nameplates at no additional cost to the City.

2. Such additional signs may be requested near completion of the work and will be limited to no more than five (5) signs for each of the five (5) types listed in Schedule 40 05 97-1.

3. Conform legends and color combinations for additional signs to the requirements specified.

I. Color of Pipelines and Equipment:

1. Paint all pipelines and equipment in conformity with the requirements of Section 09 91 00 - Painting.

a. Color code the color of the final coats of paint.

2. Match the color of the final coats as closely as possible, without custom blending, to the colors presented in Schedule 40 05 97-6, Pipeline and Equipment Identification, located after the "End of Section" designation.

a. The colors in Schedule 40 05 97-6 are identified by a name and their SAE AMSSTD595 color identification number and shall match this standard; the names of the colors in Schedules 40 05 99-6 are for convenience only.

3. Do not paint aluminum or stainless steel ductwork or jackets on insulated pipelines. Should the Contract Documents state that flanges, flexible couplings, valves, and/or fittings for such jacketed lines not be covered, paint only the flanges, flexible couplings, valves, and/or fittings in accordance with the piping color code.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Location:

1. Locate identification signs for piping along straight line runs at intervals of not more than 30 ft, near valves, branches and junction points and where pipes pass through walls or ceilings.
2. Place direction-of-flow arrows as shown or required.
3. Locate signs on large valves on or adjacent to the valve itself.
4. Place all piping identification signs so as to be easily visible from operating locations.
5. Locate nameplates on equipment bases and on structures at readily visible levels in such positions relative to the equipment and structures so as to prevent damage to the nameplate.

3.02 INSTALLATION

A. Mounting:

1. Mount identification signs and arrows on piping parallel and tangent to the pipe and valves by fastening with screws, plastic or fiber washers, threaded brackets, and banding straps and seals.
2. Provide screws and brackets of stainless steel with 5/16 - 18 American Standard Coarse Threads; provide No. 25 U.S. gauge stainless steel, /4 inch wide bands.
3. Where pipe is insulated, use care in mounting the signs so to prevent the banding straps from crushing the insulation.
4. Provide mounting assembly "Steelbinder" strapping units.
5. Mount nameplates in the manner specifically approved by the Engineer, after the installation of equipment or the construction of structures is complete.
6. Mount valve identification signs with approved stainless steel brackets or approved stainless steel strapping in such a fashion that sharp corners or edges on signs, brackets, bolts, chain or strapping will not constitute a hazard to personnel operating the valves.
7. Do not attach identification tags or signs to handwheels.
8. Use of flange bolts or bonnet bolts as a means of attachment of brackets shall receive consideration by the Engineer.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SCHEDULE 40 05 97-1
DIMENSIONS OF IDENTIFICATION SIGNS AND NAMEPLATES

Type of Sign:	**Sign Dimensions: (Width × Length)**
PIPE IDENTIFICATION -	
1. Outside diameter of pipe (including pipe insulation):	
a. 4-in. and larger:	3½-in. × 12-in.
b. Less than 4-in.:	1½-in. × 7-in.
VALVE AND GATE IDENTIFICATION -	
1. Valve and gate tags:	2-in. diameter
2. Operating stands for valves and sluice gates:	1½-in. × 7-in.
NAMEPLATES -	
1. Equipment and structures	3½-in. x 12 in.

SCHEDULE 40 05 97-2
TABLE OF STANDARD COLORS

Color:	**Munsell Number:**
White	MN - N8.8/
Yellow	MN - 4Y7.5/12.8
Orange	MN - 0.5 YR 4.6/12.2
Red	MN - 7R 3.6/12.7
Brown	MN - 2.5 YR 4.2/4.3
Gray	MN - 2.5PB 5.8/1.7
*Charcoal	MN - 6B 5/0.4
Black	MN - N1/
Blue	MN - 3PB 3.3/7.4
Green	MN - 8G 4.4/6.2
* Provide color "Charcoal" for paints equivalent to MN - N 3.75.	

SCHEDULE 40 05 97-3
GENERAL COLOR CODE

Service Line:	**Colors:**	
	Letters:	**Background:**
1. FIRE AND STANDPIPE	White	Red
2. SLUDGE OR UTILITY GAS		
a. High Pressure	Black	Orange
b. Low Pressure	White	Orange
3. FUEL OIL	Orange	White
4. LUBRICATING OIL	Black	White
5. HYDRAULIC FLUID	Red	White
6. CHEMICALS		
a. Ferric Chloride	White	Blue
b. Glycerol	Brown	Yellow
c. Methanol	Black	Yellow
d. Polymer	Brown	Yellow
e. Sodium Bisulfite	Orange	Black
f. Sodium Hydroxide	Black	Yellow
g. Sodium Hypochlorite	Blue	Yellow
h. Other (Hazardous)	Black	Yellow
i. Other (Relatively Safe)	Brown	Yellow
7. OZONE	Black	Yellow
8. CHLORINE		
a. Gas	Black	Yellow
b. Liquefied	Red	Yellow
c. Solution	Blue	Yellow
9. LIQUIDS THICK IN SOLIDS		
a. Primary Sludge	White	Black
b. Digested Sludge		

Service Line:	Colors:	
	Letters:	**Background:**
c. Thickened Sludge		
10. LIQUIDS THINNER IN SOLIDS a. Secondary Sludge b. Return Sludge c. Mixed Liquor d. Grease, Scum, Grit	White	Brown
11. LIQUIDS WEAK IN SOLIDS a. Sewage b. Effluent c. Thickening Tank Drains, Vents, Overflow d. Digester Tank Drains, Vents, Overflow e. Concentration Tank Drains, Vents, Overflow f. Storage Tank Overflow, Drains g. Settling Tank Overflow, Drains h. Sump Drains	Black	Gray
12. STRAINED EFFLUENT a. Spray Water b. Flushing Water c. Plant Water	Yellow	Gray
13. NON-POTABLE WATER a. Seal Water b. Chilled Water c. Engine Cooling Water d. Sludge Heating Water e. Hydraulic Control Water	Yellow	Blue
14. CITY WATER	White	Blue

Service Line:	**Colors:**	
	Letters:	**Background:**
15. STEAM, DANGEROUSLY HOT WATER	Blue	Orange
16. ENGINE AIR		
a. Starting	Orange	Green
b. Intake	Yellow	Green
17. ENGINE EXHAUST	Yellow	Orange
18. VACUUM SERVICE	Black	Green
19. PLANT SERVICE (COMPRESSED) AIR	White	Green
20. PROCESS (BLOWER) AIR	Gray	Green
21. HIGH PRESSURE AIR	Orange	Green
22. HEATING, VENTILATING AND CONDITIONING AIR (Equipment And Ductwork)	Green	Charcoal

SCHEDULE 40 05 97-4
PIPE IDENTIFICATION SIGNS

Legend:	**Service:**	**Color Code:**	
		Lettering:	**Background:**
BLOWER LUBE	Blower lube oil	Black	White
BLOWOFF	Blowoff	*	*
CAUSTIC	Caustic soda (Sodium hydroxide)	Black	Yellow
CHILL SUPPLY	Chilled water supply	Yellow	Blue
CHILL RETURN	Chilled water return	Yellow	Blue
CHLORINE GAS	Chlorine gas	Black	Yellow
CHLOR. LIQ.	Liquefied chlorine	Red	Yellow
CHLOR. SOL.	Chlorine solution	Blue	Yellow
COMP. AIR	Compressed or plant service air	White	Green
CONDENSATE	Condensate	Yellow	Blue
DEFOAMANT	Defoamant or foam control	Brown	Yellow
DIESEL FUEL	Diesel fuel oil	Orange	White
DIGEST. SL.	Digested sludge	White	Black
DIG. O'FLOW	Digester overflow	Black	Gray
DISINFECT	Disinfectant	Brown	Yellow
DRAIN - *	Drain - *	*	*
EFFLUENT	Effluent water	Black	Gray
ENGINE AIR	Engine air intake	Yellow	Green
ENG. EXHAUST	Engine exhaust	Yellow	Orange
ENGINE LUBE	Engine lube oil	Black	White

Legend:	**Service:**	**Color Code:**	
		Lettering:	**Background:**
ENGINE VENT	Engine crankcase vent	Black	White
EXCESS SLUDGE	Excess sludge	White	Black
EXH. BLOWOFF	Exhaust silencer blowoff	Red	Blue
FERRIC	Ferric chloride	White	Blue
FIRE	Fire line	White	Red
FLUSH. WATER	Pump flushing water	Yellow	Gray
FLY ASH	Wet fly ash	White	Black
FUEL OIL	Fuel oil	Orange	White
FUEL FILL	Fuel oil fill	Orange	White
GAS – SLUDGE	Sludge gas	White	Orange
GAS – UTILITY	Utility gas	White	Orange
GAS – HP	Sludge or utility gas – high pressure	Black	Orange
GLY	Glycerol	Brown	Yellow
GREASE	Grease	White	Brown
GRIT	Grit	White	Brown
HI PRESS. AIR	High pressure air	Orange	Green
H.W. RETURN	Hot water return	Blue	Orange
H.W. SUPPLY	Hot water supply	Blue	Orange
HYDRAULIC	Hydraulic fluid	Red	White
HYPOCHLORITE	Sodium hypochlorite	Blue	Yellow
INSTR. AIR	Instrument air	White	Green
JACKET WATER	Engine jacket water	Yellow	Blue

Legend:	**Service:**	**Color Code:**	
		Lettering:	**Background:**
LUBE	Lubricating oil	Black	White
LUBE FILL	Lubricating oil fill	Black	White
METER - *	Metering - *	*	*
METHANOL	Methanol	Black	Yellow
MIXED LIQUOR	Mixed liquor	White	Brown
MIXED SLUDGE	Mixed sludge	White	Brown
MODIFIED SL.	Modified sludge	White	Brown
O'FLOW - *	Overflow - *	*	*
OZONE	Ozone	Black	Yellow
PLANT DRAIN	Plant drain	Black	Gray
PLANT WATER	Plant water	Yellow	Gray
POLYMER	Polymer	Brown	Yellow
PRIMARY SL.	Primary sludge	White	Black
PROCESS AIR	Process or blower air	Gray	Green
RECIRC. SL.	Recirculated sludge	White	Brown
RETURN SL.	Return sludge	White	Brown
SBS	Sodium bisulfite	Orange	Black
SCUM	Scum	White	Brown
SEAL WATER	Seal water	Yellow	Blue
SECOND. SL.	Secondary sludge	White	Brown
SEWAGE	Sewage	Black	Gray
SEW. SAMPLE	Sewage sampling	Black	Gray
SPRAY WATER	Spray water	Yellow	Gray

Legend:	**Service:**	**Color Code:**	
		Lettering:	**Background:**
STARTING AIR	Starting air	Orange	Green
STEAM	Steam	Blue	Orange
SUMP - *	Sump pump line - *	*	*
SUPERNATANT	Supernatant	Black	Gray
THICK. DR.	Thickener drain	Black	Gray
THICK. EFF.	Thickener effluent	Black	Gray
THICK. SL.	Thickened sludge	White	Black
TREAT. WATER	Chemically treated boiler feed water	Brown	Yellow
VACUUM	Vacuum line	Black	Green
VENT - *	Vent - *	*	*
WASTE GAS	Waste gas	White	Orange
WASTE OIL	Waste lubricating oil	Black	White
WATER	City water	White	Blue
* Where shown, specified or required, the legend for blowoff, drain, metering, sump, vent and similar lines shall also include the equipment, structure or identification number to which the service applies.			

SCHEDULE 40 05 97-5
NAMEPLATES

Legend:		**Color Code:**	
First Line(1):	**Second Line(2):**	**Lettering:**	**Background:**
AIR BLOWER	**	White	Charcoal
AIR COMPRESSOR	**	White	Green
AIR HANDLING	UNIT **	White	Charcoal
AIR CONDITIONING	UNIT **	White	Charcoal
AUXILIARY ELECTRIC	GENERATOR **	Red	Green
AUXILIARY LUBE	OIL PUMP **	Black	White
BAR SCREEN	**	Black	Gray
BLOWER CONTROL	CABINET **	Gray	Green
BLOWER CONTROL AIR	RECEIVER **	White	Green
BLOWER LUBE OIL	AUX. PUMP **	Black	White
BLOWER LUBE OIL	COOLER **	Black	White
BLOWER LUBE OIL	RESERVOIR **	Black	White
BLOWER SILENCER	**	Gray	Green
BULK LUBE OIL	STORAGE **	Black	White
BYPASS OIL FILTER	**	Black	White
CHILLERS	**	White	Blue
CLEAN LUBE OIL	TANK **	Black	White
CONCENTRATION TANK	**	White	Black
CONDENSATE PUMP	**	Yellow	Blue
CONDENSATE RECEIVER	**	Yellow	Blue
CONDENSER	WATER COOLED **	Yellow*	Blue*
CONDENSER	AIR COOLED **	Yellow*	Blue*
CONE VALVE AIR	RECEIVER **	White	Green
DESCALER	**	Yellow	Blue
DIESEL TANK	**	Orange	White

Legend:		**Color Code:**	
First Line(1):	**Second Line(2):**	**Lettering:**	**Background:**
DIGESTION TANK	**	White	Black
DIRTY LUBE OIL	TANK **	Black	White
EFFLUENT-LUBE OIL	COOLER **	Yellow	Gray
EFFLUENT WATER	STRAINER **	Yellow	Gray
EFFLUENT WATER	PUMP **	Black	Gray
EFFLUENT WATER	TANK **	Yellow	Gray
ENGINE GENERATOR	**	Red	Green
ENGINE J.W.	MAKEUP	Yellow	Blue
ENGINE LUBE OIL	PURIFIER **	Black	White
ENGINE LUBE OIL	TANK **	Black	White
ENGINE OIL SUMP	TANK **	Black	White
EXHAUST FAN	**	White	Charcoal
EXCESS SLUDGE	DISTRIB. BOX **	White	Black
EXHAUST STEAM	CONVERTER **	Blue	Orange
FAN COIL UNITS	**	Blue*	Orange*
FLUSHING WATER	PUMP **	Yellow	Gray
FUEL OIL	PUMP **	Orange	White
FUEL OIL TANK	NO. 2 OIL **	Orange	White
FUEL OIL TANK	NO. 4 OIL **	Orange	White
FUEL OIL TANK	NO. 6 OIL **	Orange	White
FULL FLOW OIL	FILTER **	Black	White
GAS BOOSTER	**	Black	Orange
GASOLINE TANK	**	Orange	White
GAS COMPRESSOR	**	Black	Orange
GAS RECEIVER	**	Black	Orange
GAS SURGE TANK	**	White	Orange
HEAT EXCHANGER	OIL **	White	Orange
HEAT EXCHANGER	STEAM-WATER **	Blue	Orange

Legend:		**Color Code:**	
First Line(1):	**Second Line(2):**	**Lettering:**	**Background:**
HEAT EXCHANGER	WATER-WATER **	Blue	Orange
HEAT RECOVERY	SILENCER **	Yellow	Orange
HEAT. & VENT.	UNIT **	White	Charcoal
HIGH PRESSURE AIR	COMPRESSOR **	Orange	Green
HIGH PRESSURE AIR	DRYER **	Orange	Green
HIGH PRESSURE AIR	RECEIVER	Orange	Green
HOT WATER BOILER	**	Blue	Orange
HOT WATER CONVERTER	DOMESTIC **	Blue	Orange
HOT WATER HEATER	ELECTRIC **	Blue	Orange
HOT WATER GENERATOR	DOMESTIC **	Blue	Orange
HYDRO-PNEUMATIC	TANK **	White	Blue
INLET SLUICE GATE	CYLINDER **	Red	White
JACKET WATER CIRC.	PUMP **	Yellow	Blue
JACKET WATER	COOLER **	Yellow	Blue
JACKET WATER ENG.	OIL COOLER **	Yellow	Blue
LUBE OIL	PURIFIER **	Black	White
LUBE OIL STORAGE	PUMP **	Black	White
LUBE OIL STORAGE	TANK **	Black	White
LUBE OIL TRANSFER	PUMP **	Black	White
MIXED SLUDGE	PUMP **	White	Brown
OUTLET SLUICE GATE	CYLINDER **	Red	White
OZONATOR	**	Black	Yellow
PLANT AIR	AFTERCOOLER **	White	Green
PLANT AIR	COMPRESSOR **	White	Green
PLANT AIR	RECEIVER **	White	Green
PLANT WATER	MAKEUP **	Yellow	Gray
PLANT WATER	TANK **	Yellow	Gray

Legend:		**Color Code:**	
First Line(1):	**Second Line(2):**	**Lettering:**	**Background:**
PLANT WATER	PUMP **	Yellow	Gray
PUMP – CHILLED WATER	**	White	Blue
PUMP – CONDENSER WATER	**	Yellow	Blue
PUMP – DOMESTIC	HOT WATER **	White	Blue
PUMP – FEED WATER	**	Yellow	Blue
PUMP – FIRE	**	White	Red
RETURN FAN	**	White	Charcoal
RETURN SLUDGE	PUMP **	White	Brown
SCUM PIT	**	White	Brown
SEAL WATER	PUMP **	Yellow	Blue
SEWAGE EJECTOR	**	Black	Gray
SEWAGE FLOW	METER **	Black	Gray
SEWAGE PUMP	**	Black	Gray
SLUICE GATE CONT.	AIR CHAMBER **	White	Green
SLUICE GATE CONT.	AIR TANK **	White	Green
SLUICE GATE HYD.	FLUID PUMP **	Red	White
SLUDGE HEATER	**	White	Black
SLUDGE HEATING H.W.	CIRC. PUMP **	White	Orange
SLUDGE HEAT WATER	MAKEUP TANK **	Yellow	Blue
SLUDGE DOCK	PUMP **	White	Black
SLUDGE RECIRC.	PUMP **	White	Brown
SLUDGE STORAGE	TANK **	White	Black
SLUDGE TRANSFER	BOX **	White	Black
SLUDGE TRANSFER	PUMP **	White	Black
SPRAY WATER	PUMP **	Yellow	Gray
STANDBY GENERATOR	**	Red	Green
STARTING AIR	COMPRESSOR **	Orange	Green

Legend:		**Color Code:**	
First Line(1):	**Second Line(2):**	**Lettering:**	**Background:**
STARTING AIR	TANK **	Orange	Green
STEAM BOILER	**	Blue	Orange
SUMP PUMP	**	Black	Gray
SUMP PUMP – CONC.	TANK **	Black	Gray
SUMP PUMP – DIGEST.	TANK **	Black	Gray
SUMP PUMP – EFF.	VAULT **	Black	Gray
SUPPLY FAN	**	White	Charcoal
THICKENER	**	White	Black
TRASH RACK	**	Black	Gray
UNIT HEATER – STEAM	**	White*	Charcoal*
UNIT HEATER – WATER	**	White	Charcoal*
WASTE LUBE OIL	PUMP **	Black	White
WASTE LUBE OIL	TANK **	Black	White
WATER TREATMENT	PUMP **	Brown	Yellow
WATER TREATMENT	TANK **	Brown	Yellow

(1) Nominal limit of 18 letters, numerals and spaces.
(2) Nominal limit of 17 letters, numerals and spaces.

*Where equipment is mounted on roofs or where exposed to the public view, such as in lobby or office areas, the color will be selected by the Architect.

**The legend on these nameplates also includes the appropriate six-digit numeral and letter designation for such equipment and structures as specified by the Operation and Maintenance Manual.

SCHEDULE 40 05 97-6
PIPELINE AND EQUIPMENT IDENTIFICATION

Abbr.:	**Process/Service Line:**	**Fed. Std. 595B Color:**
AD	Aerator Drain	Gray 16187
APLM	Anionic Polymer	Green 14090
BLW	Balance Water	Blue 15193
BLO	Blower Lube Oil	White 17925
CPLM	Cationic Polymer	Green 14090
CSTC	Caustic (Sodium Hydroxide)	Orange 22544
CEN	Centrate	Gray 16492
CF	Centrifuge Feed	Black 14036
CHA	Channel Air	Green 14260
CHWR	Chill Water Return	Blue 17877
CHWS	Chill Water Supply	Blue 15450
CHEFF	Chlorinated Effluent	Gray 17875
CW	City Water	Blue 15200
CLD	Clarifier Drain	Gray 16187
CLWR	Cold Water Return	Blue 15187
CLWS	Cold Water Supply	Blue 15125
CA	Compressed Air (Plant Air)	Green 14449
CCSK	Concentrated Skimmings	Tan 17778
CSB	Concentrator Subnatant	Gray 16314
C	Condensate	Gray 16357
CTD	Contact Tank Drain	Gray 16187
DFM	Defoamant	Pink 11630
DGOF	Degrit Overflow	Gray 16250
DGS	Degritted Primary Sludge	Olive 14257
DWS	Dewatered Sludge	Navy 15044
DF	Diesel Fuel	Mustard 13275

Abbr.:	Process/Service Line:	Fed. Std. 595B Color:
DSD	Digested Sludge Disposal	Brown-black 10032
RCD	Digested Sludge Recirculation (mixing)	(See Note 1)
DSR	Digested Sludge Recycle	Black 14084
DSS	Digested Sludge to Storage	Black 17038
DST	Digested Sludge Transfer	Gray 16081
DSK	Dilute Skimmings	Tan 16405
ELF	Elutriation Feed	Black 15042
ECWR	Engine Cooling Water Return	Gray 15526
ECWS	Engine Cooling Water Supply	Navy 15045
EXH	Engine Exhaust	Stainless Steel Jacket
ELO	Engine Lube Oil	White 17925
FECL	Ferric Chloride	Blue 15095
FEF	Final Effluent	Gray 16492
FRS	Fire and Standpipe	Red 11350
FW	Flushing Water	Blue 15090
FF	Fuel Fill	Tan 10266
FO	Fuel Oil	Brown 16160
	Gasoline Fill Port – high octane	Red 11086
	Gasoline Fill Port – middle octane	Blue 15056
	Gasoline Fill Port – low octane	White 17925
	Gasoline Fill Port, unleaded – high octane	Red 11086 with white 17925 cross
	Gasoline Fill Port, unleaded – middle octane	Blue 15056 with white 17925 cross
	Gasoline Fill Port, unleaded – low octane	White 17925 with black 17038 cross
	Gasoline Vapor Recovery	Orange 12246
GRIT	Grit	Gray 14064
HPAR	High Pressure Air (Plant Air)	Green 14272
DG(H)	High Pressure Digester Gas	Orange 22510

Abbr.:	Process/Service Line:	Fed. Std. 595B Color:
HPUGS	High Pressure Utility Gas	Orange 22510
HWR	Hot Water Return (heating)	Orange 12215
HWS	Hot Water Supply (heating)	Orange 11400
HVACEX	HVAC Exhaust	Gray 14158
HVACR	HVAC Return	Gray 14077
HVACS	HVAC Supply	Gray 14056
HCW	Hydraulic Control Water	Blue 15107
HOR	Hydraulic Oil Return	Brown 10059
HOS	Hydraulic Oil Supply	Brown 10045
ITK	Intake (Engine Air)	Green 14672
JKWR	Jacket Water Return	Gray 15109
JKWS	Jacket Water Supply	Navy 15050
	Kerosene Fill Port	Brown 20100
LM	Lime	Tan 13740
DG(L)	Low Pressure Digester Gas	Orange 22510
LPUGS	Low Pressure Utility Gas	Orange 22510
LF	Lube Fill	White 17925
MH	Methanol	Brown 10233
MS	Mixed Sludge (heating)	(See Schedule 40 05 97-7)
ODCDW	Odor Control Draw	Green 14110
ODCVT	Odor Control Vent	Unpainted
O2	Oxygen	Red 11105
OZR	Ozone Recycle	Blue 15177
OZS	Ozone Supply	Blue 15080
OZVT	Ozone Vent	Blue 15180
PD	Plant Drain	Gray 16187
PW	Plant Water	Blue 15092

Abbr.:	Process/Service Line:	Fed. Std. 595B Color:
PTPM	Potassium Permanganate	Red 11140
PEFF	Primary Effluent	Gray 16251
PA	Process Air	Green 14115
RINF	Raw Influent	Gray 16293
RPS	Raw Primary Sludge	Olive 14151
RSC	Raw Screenings	Tan 16350
RAS	Return Activated Sludge	Tan 10260
SMP	Sampling Line	(Match to Service)
SLW	Seal Water	Blue 15182
SBP	Secondary Bypass	Gray 16473
SAR	Service Air (Plant Air)	Green 14193
SW	Service Water	Blue 15102
SHW	Sludge Heating Water	Orange 12473
NA2SO3	Sodium Bisulfite	Black 14084
NAOCL	Sodium Hypochlorite	Yellow 13591
SPW	Spray Water	Navy 15052
STA	Starting Air (Engine Air)	Green 14187
STMR	Steam Return (Condensate)	Tan 11670
STMS	Steam Supply	Orange 22356
STD	Storm Drain	Gray 16440
SULAD	Sulfuric Acid	Brown 10049
SD	Sump Drain	Gray 16376
SU	Supernatant	Gray 16307
TS	Thickened Sludge	Brown 10070
TD	Thickener Drain	Gray 16187
TO	Thickener Overflow	Gray 16329
VCS	Vacuum Service	Green 14062
WAS	Waste Activated Sludge	Tan 13596

Abbr.:	Process/Service Line:	Fed. Std. 595B Color:
WDGS	Waste Digester Gas	Orange 22510
WML	Waste Mixed Liquor	Tan 12648
WO	Waste Oil	White 17925
WSC	Washed/Compacted Screenings	Black 14084

SCHEDULE 40 05 97-7

MIXED SLUDGE AND DIGESTED SLUDGE RECIRCULATION PIPELINE AND EQUIPMENT IDENTIFICATION

Digester No.:	Color:	Digester No.:	Color:
1	13531	5	10219
2	13522	6	10115
3	10324	7	10080
4	10371	8	10055

NO TEXT ON THIS PAGE

SECTION 40 06 01 – SCHEDULE FOR EXPOSED PIPING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all exposed piping as indicated in the exposed piping schedule, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	2
PART 2	PRODUCTS	2
2.01	Manufacturers	2
2.02	Materials / Equipment	2
2.03	Fabrication / Assembling / Finishes	2
2.04	Source Quality Control / Shop Tests	2
PART 3	EXECUTION	3
3.01	Examination / Preparation	3
3.02	Installation	3
3.03	Field Testing / Quality Control	3
3.04	Startup / Demonstration	3
3.05	Adjusting / Protection / Cleanup	3

C. The following schedule(s), attached after the End of Section designation, are a part of this Section:

1. Schedule 40 06 01-1, Exposed Piping Schedule.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. 40 05 05 – Exposed Piping Installation

B. 40 05 05.30 – Leakage Testing for Exposed Piping
C. 40 05 06 – Couplings, Adapters, and Specials for Process Piping
D. 40 05 07 – Hangers and Supports for Process Piping
E. 40 05 15 – Copper and Brass Process Pipe
F. 40 05 19 – Ductile Iron Process Pipe

1.04 REFERENCES
A. Not Used

1.05 DESCRIPTION
A. Not Used

1.06 QUALITY ASSURANCE
A. Not Used

1.07 SUBMITTALS
A. Not Used

1.08 DELIVERY, STORAGE, AND HANDLING
A. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES
A. Not Used

1.10 WARRANTY
A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Not Used

2.02 MATERIALS / EQUIPMENT
A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES
A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS
A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SCHEDULE 40 06 01-1
EXPOSED PIPING SCHEDULE

Service Name	Material	Wall Thickness/ Schedule/ Class	Type of Joint	Working Pressure (psig)	Test Type	Test Pressure (psig)	Interior Coating	Exterior Coatings, Treatments	Remarks
RWW	DI	Class 56	Flg	11	Hyd	60	CEL	PE	CEL thickness shall be minimum forty (40) miles thick.
SD	DI	Class 54	Flg	N/A	Inf/Exf	N/A	CEL	PE	CEL thickness shall be minimum forty (40) miles thick.
W1	Cu	Type K	Sld	50	Hyd	100	N/A	N/A	
W2	Cu	Type K	Sld	50	Hyd	100	N/A	N/A	
D	PVC	Schedule 40	SW	50	Hyd	100	N/A	N/A	
SPD	PVC	Schedule 80	SW	50	Hyd	100	N/A	N/A	
V	PVC	Schedule 40	SW	N/A	Hyd	N/A	N/A	N/A	

B. The following service abbreviations are used in Schedule 40 06 01-1:

Service:	**Abbrev:**	**Service:**	**Abbrev:**
Raw Wastewater	RWW	Drain	D
Storm Drain	SD	Sump Pump Discharge	SPD
Potable Water	W1	Vent	V
Service Water	W2	--	--

C. The following pipe material abbreviations are used in Schedule 40 06 01-1:

Pipe Material:	**Abbrev:**	**Pipe Material:**	**Abbrev:**
304L Stainless Steel	304L SS	Ductile Iron	DI
316L Stainless Steel	316L SS	Fiber-Reinforced Plastic	FRP
Brass	Brass	High Density Polyethylene	HDPE
Carbon Steel	CS	Polytetrafluoroethylene	PTFE
Chlorinated PVC	CPVC	Polyvinyl Chloride	PVC
Copper	Cu	Stainless Steel	SS

D. The following joint type abbreviations are used in Schedule 40 06 01-1:

Joint Type:	**Abbrev:**	**Joint Type:**	**Abbrev:**
Bell and Spigot	BS	Push-on Joint	POJ
Brazed	Brz	Shouldered End Coupling	SEC
Butt Weld	BW	Split-sleeve Coupling	SSC
Flanged	Flg	Soldered	Sld
Flexible Tube Connector	Flex	Solvent Weld	SW
Grooved End Coupling	GEC	Restrained Mechanical Joint	RMJ
Grooved / Shouldered End Coupling	GSEC	Restrained Push-on Joint	RPOJ
Lap Welded	LW	Threaded	Thd
Mechanical Joint	MJ	Welded	Wld

E. The following interior coating abbreviations are used in Schedule 40 06 01-1:

Interior Coating	**Abbrev:**	**Interior Coating:**	**Abbrev:**
Asphalt Coated	AC	Cement Lined	CL
Basalt Coated	BC	EPDM (M-class) Rubber	EPDM
Ceramic Epoxy Coated	CEC	Glass Lined	GL
Ceramic Epoxy Lined	CEL	Polyethelene Lined	PEL

F. The following exterior coating and treatment abbreviations are used in Schedule 40 06 01-1:

Exterior Coating, Treat.:	**Abbrev:**	**Exterior Coating, Treat.:**	**Abbrev:**
Asphalt Coated	AC	Galvanized	Galv
Epoxy	Epx	Insulate	I
Heat Trace	HT	Paint	P
Polyethylene Encasement	PE	--	--

G. The following testing abbreviations are used in Schedule 40 06 01-1:

Test Type:	**Abbrev:**	**Test Type.:**	**Abbrev:**
Hydrostatic	Hyd	Infiltration	Inf
Exfiltration	Exf	--	--

SECTION 40 23 19.01 – PIPE SUPPORTS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specific and required to furnish, install, and test all pipe supports, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	7
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	11
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures

B. Section 01 43 10 – Quality Assurance Inspection

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 09 91 00 - Painting

1.04 REFERENCES

A. The American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. ASTM International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel
2. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
3. A312: Seamless and Welded Austenic Stainless Steel Pipe
4. A500: Cold Formed Welded and Seamless Carbon Steel Structural Tubing.
5. A572: Specification for Steel Plate.
6. E165: Practice for Liquid Penetrant Inspection Method.
7. E709: Practice for Magnetic Particle Examination.

C. American Welding Society (AWS):

1. D1.1: Structural Welding

D. Fluid Sealing Association: Technical Handbook.

E. Manufacturers' Standardization Society (MSS):

1. SP-58: Pipe Hangers and Supports - Materials and Design.
2. SP-69: Pipe Hangers and Supports - Selection and Application.
3. SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.
4. SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

F. National Association of Expansion Joint Manufacturers: Standards of the Expansion Joint Manufacturers Association, Inc.

1.05 DESCRIPTION

A. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and in compliance with Contract Documents. The term pipe support includes hangers, guides, restraints, anchors and saddles.

B. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.

C. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all pipe supports in accordance with the specified requirements.

D. Pipe support locations and types for piping 1/2-inch (13 mm) and larger shall be determined by the Contractor using the guidelines for support spacing specified

herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For pipe supports 1/2-inch (13 mm) and larger pipe support shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.

1. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified herein.

E. Design and provide all temporary pipe supports required during installation and testing.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Section 01 43 10 – Quality Assurance Inspection and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.

E. Structural Concrete: Conform to the requirements of Section 03 30 00 – Cast-in-Place Concrete. Concrete strength: 4,000 PSI (28 MPa) unless noted otherwise.

F. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.

G. Pipe Support Manufacturer Qualifications:

1. Must possess a written quality assurance program.

2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.

3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.

4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.

5. Manufacturers' Standardization Society (MSS) Member.

6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components.

H. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

1.07 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

1. Pipe support drawings specified herein and including data for accessory items for acceptance prior to fabrication. The Contractor shall submit pipe support coordination drawings including all piping and pipe supports for all trades.

   a. Detailed drawing of the device with dimensions.

   b. A table of applied forces and moments.

   c. A complete bill of materials.

   d. A unique identification and revision level.

   e. Stamp of a Registered Professional Engineer, registered in the state where this project is being constructed, experienced in pipe support design and pipe stress analysis as specified herein.

   f. Detailed connections to existing structure.

   g. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1.

2. Welding Procedure: Submit description required to illustrate each welding procedure to be performed in the specified work.

3. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.

4. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to DEP.

5. Pipe support manufacturers' qualifications as specified herein.

a. List of at least five (5) successful pipe support projects and current addresses and telephone numbers of persons in charge of representing the owner or the owner of those construction projects during the time of pipe support design, fabrication and installation.

b. Qualification of manufacturers' Registered Professional Engineer, registered in the state where this project is being constructed, who stamps and seals shop drawings and designs.

6. Coordination drawings for pipe supports shall include as a minimum the following information.

a. Coordination drawings shall include all pipe supports covered by specifications.

b. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.

c. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.

d. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4-inch (5 mm) scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-inches (50 mm) or less in diameter that will be field routed need not be shown on coordination drawings.

e. Coordination drawings shall include large-scale details as well as cross and longitudinal sections required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.

f. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the City. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Owner shall be notified. Any problems of coordination that require architectural or structural changes of design shall be submitted to the Owner for resolution.

g. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the

Contractor and all subcontractors indicating that all work on that drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.

h. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to DEP.

7. Written notification of any deviations from the requirements of this specification.

8. Support documentation and justification as specified.

9. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.

10. Manufacturer's product data and specifications for shop painting.

B. Material Certification:

1. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to DEP.

2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements specified in Section 01 66 00 – Protection of Materials & Equipment.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Provide materials used in pipe supports, which are compatible with the pipes to which they are attached. Provide Type 316L stainless steel supports for all stainless steel piping. Copper plated pipe supports are not acceptable.

B. Allowable materials: As indicated in ANSI B31.1 Appendix A and MSS-SP-58 Table 2.

C. Provide Type 316L stainless steel for pipe supports, hangers, guides, restraints, and anchors that are exterior or interior submerged, in potentially wetted areas in wet wells, channels, screening and grit removal areas and in chemically corrosive atmospheres.

D. Provide only new material. Previously used and/or scrap material is not acceptable.

E. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.

F. Provide sliding Teflon plates. The sliding surfaces shall be a nominal 3/8-inches (10 mm) glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product.

1. The blended TFE material used for this bearing shall be composed of virgin (unreprocessed) TFE resin tested per ASTM D1457 and reinforcing agents

milled glass fibers. This structural material shall have the following representative mechanical and physical properties:

2. Tensile strength -2,000 psi (14 MPa).
3. Elongation –225 percent
4. Specific Gravity -2.17 to 2.22
5. The coefficient of friction shall average 0.06 under compressive load of 2,000 psi (14 MPa).
6. The compressive creep shall be a minimum of 2 percent at 2,000 psi (14 MPa) and 70 degrees F (21 degrees C).
7. The elements shall be flat, clean and prepared for installation in the structure. Slots and holes shall be fabricated in the bearing manufacturer's plant.

G. Concrete anchor bolts - Hilti Kwik-Bolt II Stud Anchors, Rawl Bolt, Phillips Wedge Anchors, or equal.

H. Design, Location, And Type Of Pipe Supports:

1. Design and provide pipe supports for piping 1/2-inch (13 mm) and larger to include the following loads:
   a. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.
   b. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.
   c. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.
   d. Wind Loadings: Wind loadings.
2. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.
3. For all pump suction and discharge nozzles provide an anchor located between the pump nozzles and the nearest expansion joint or non-rigid coupling.
4. Where possible, provide pipe supports, which are the manufacturers' standard products.
   a. Provide pipe supports with individual means of adjustment for alignment.

b. Provide pipe supports complete with appurtenances including locking and adjusting nuts.

c. Hanger rods shall be subjected to tension only.

d. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.

e. Provide concrete inserts capable of supporting the design loads.

f. Metal framing systems will be acceptable to support piping 2 inch (50 mm) and smaller.

g. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge (1.5 mm) shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 inch (300 mm) in length.

h. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.

i. Provide supplementary steel as needed.

j. Do not support pipes from other pipe, conduits or metal stairs.

k. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.

l. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.

m. All pipe supports located in fluid flow shall be supplied with double nutting.

5. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes.

6. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.

7. For piping 2-inch (50 mm) and smaller provide manufacturer’s standard supports and standard spacing guidelines

8. Pipe supports connected to structural framing and slabs are subject to the following limitations:

   a. Less than 100 lb (45 kg) horizontal load per support.

b. Vertical loads not to exceed an average of 10 P.S.F. (0.5 kPa) for slabs, with a maximum vertical load per hanger of 50 lbs. (23 kg).

c. For a maximum of one pipe support per foot (300 mm) of slab width perpendicular to the span.

d. Vertical loads not to exceed 300 lbs. (136 kg) per column or 300 lbs. (136 kg) per support at walls.

e. Piping not supported from floors by metal framing must meet the limitations as specified above.

9. All outside above ground supports shall be Type 316L stainless steel as specified herein.

10. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.

11. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.

B. Providing welding in accordance with Structural Welding Code

C. Provide dimensional tolerances as specified in MSS-SP-89.

D. Provide threading and tapping in accordance with MSS-SP-89.

E. Shop Painting:

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09 91 00 - Painting.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.

B. Perform welding in accordance with Structural Welding:

1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. The Qualified Inspector shall inspect the preparation of grove welds for throat opening and for snug positioning for back-up bars.

2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.

3. Magnetic Particle Inspection: Perform in accordance with ASTM E709.

4. Liquid Penetrant Inspection: Perform in accordance with ASTM E165.

5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to DEP.

6. Test Locations: As selected by the City.

7. Correct any deficiencies detected as directed by the Engineer at no additional cost to DEP.

C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in Section 03 30 00 – Cast-in-Place Concrete.

D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.

E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.

F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.

G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or required by the Contractor's pipe support systems. Where hanger

rod swing length cannot be provided or where pipe movement based on expansion of 1 inch/100 feet (10 mm/10 m), for each 100 degrees F (50 degrees C) change in temperature exceed 1/2-inch (13 mm), provide sliding supports.

I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8-inch (3 mm) thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.

J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.

K. Apply an anti-seize compound to nuts and bolts on all pipe supports.

L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.

M. Support piping from structural framing, unless otherwise indicated.

N. Concrete Inserts:

1. Use existing embedded concrete items whenever possible.

2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

O. Thrust Anchors:

1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.

2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.

P. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

Q. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.

R. Provide minimum of two pipe supports for each pipe piece.

S. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.

T. Provide pipe supports so that there is no interference with maintenance or removal of equipment.

U. Unless otherwise indicated or authorized by the Engineer, place piping running parallel to walls approximately 1-1/2 inch (40 mm) out from face of wall and at least 3 inches (75 mm) below ceiling.

V. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.

W. Piping supports for vertical piping passing through floor sleeves: use hot dipped galvanized steel riser clamps.

X. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.

Y. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

Z. Do not support piping from other piping.

AA. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.

BB. Whenever possible, pipe attachments for horizontal piping shall be pipe clamps.

CC. All rigid rod hangers shall provide a means of vertical adjustment after erection.

DD. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.

EE. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.

FF. Hanger spacing shall not exceed the spacing listed below:

1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.

2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.

GG. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.

HH. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

II. All threads shall be UNC unless otherwise specified.

JJ. TFE slide bearing plates with steel backup plates shall be stitch weld attachments to the structure. A 1/8-inch (3 mm) fillet weld, 1/2-inch (13 mm) long every 3

inches (75 mm) on center each side of an element shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.

KK. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

LL. Where vapor barriers are indicated on water piping, install coated protective shields.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 61 13 - PMCS GENERAL REQUIREMENTS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate and place in operation a complete PMCS. The PMCS shall be as specified in this Section, the Sections listed in the Related Sections of this Section, and as shown on the Contract Drawings.

B. PMCS shall be designed to control, monitor, store, display and log process and equipment operating information and alarms and to perform various control functions and generate various alarms.

C. The unit processes which the PMCS shall control and monitor are shown on the Contract Drawings and described herein.

D. Contractor shall coordinate with all PMCS equipment manufacturers to ensure that all control and instrumentation signals are incorporated properly.

E. P&IDs, Specifications of Division 40 and the Related Sections of this Section illustrate and describe the overall PMCS functional and operational requirements.

F. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	References	2
1.05	Description	5
1.06	Quality Assurance	6
1.07	Submittals	13
1.08	Delivery, Storage, and Handling	20
1.09	Spare Parts, Special Tools, and Supplies	20
1.10	Warranty	21
PART 2	PRODUCTS	21
2.01	Manufacturers	21
2.02	Materials / Equipment	21
2.03	Fabrication / Assembling / Finishes	23
2.04	Source Quality Control / Shop Tests	24
PART 3	EXECUTION	24
3.01	Examination / Preparation	24
3.02	Installation	24
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	25
3.05	Adjusting / Protection / Cleanup	25

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 27 - Grounding.

B. Section 26 05 53 - Identification for Electrical Systems.

C. Section 26 29 13 - Enclosed Controllers

D. Section 40 80 81 - PMCS Factory Testing

E. Section 40 61 26 - PMCS Training

F. Section 40 61 93 - PMCS Input Output List

G. Section 40 61 94 - PMCS Instrument Index

H. Section 40 61 95 - PMCS Monitoring and Control Criteria

I. Section 40 61 96 - PMCS Control Strategies

J. Section 40 63 43 - PMCS Programmable Logic Controllers

K. Section 40 67 16 - PMCS Panels and Enclosures

L. Section 40 78 90 - PMCS Panel Mounted Instruments and Devices

M. Section 40 79 91 - PMCS Field Instruments

N. Section 40 80 81 - PMCS Factory Test

O. Section 40 80 82 - PMCS Startup and Field Testing

P. Section 43 23 31.05 - Vertical Centrifugal Pumping Units

1.04 REFERENCES

A. Definitions

1. AI - Analog Input
2. AO - Analog Output
3. Area Process - A number of unit processes grouped either because of their similar equipment operation or similar function in a Plant. Area Process also comprise groupings of dissimilar unit processes designated a single group function.
4. CPU - Central Processing Unit
5. CS - Control Strategy

6.	DCAS	-	Department of Citywide Administrative Services
7.	DEP BIT	-	DEP Bureau of Business Information Technology.
8.	DI	-	Digital Input
9.	Distributed I/O	-	Hardware specifically designed to function as Remote I/O.
10.	Distributed Control System	-	A control system comprising Unit and Area Process connected by a communication network which facilitates control and monitoring of the entire system from a central point such as a Plant control room.
11.	DO	-	Digital Output
12.	Fixed PLC	-	PLC whose hardware configuration comprises a fixed number of I/O, a CPU and power supply all in one enclosure.
13.	HMI	-	Human Machine Interface are electronic displays and windows providing operator access to monitor access and set parameters of a Unit Process control system.
14.	I/O	-	Input/Output
15.	Modular	-	A style of PLC assembly where I/O, CPU and power supply are each mounted in cards which are insertable to a mounting chassis or backplane.
16.	OAD	-	Operational Availability Demonstration
17.	OIT	-	Operator Interface Terminal; another name for HMI.
18.	[Panel] or [Control Panel]	-	Panel or Control Panel includes any enclosure provided to house electrical equipment, instrumentation, controls wiring terminations, network hardware or connections, indicators, displays, computer hardware, panels of packaged systems etc. provided under any Section of this Contract
19.	P&ID	-	Process and Instrumentation Diagrams or included in the Contract Documents.
20.	Plant	-	Pumping Station

21.	PLC	-	Programmable Logic Controller
22.	PMCS	-	Pumping Station Monitoring and Control System
23.	PPU	-	Portable Programming Unit
24.	Remote I/O	-	Any I/O that functions physically remote from the location of the CPU and I/O located on its backplane.
25.	SFT	-	Start-up and Field Testing
26.	Unit Process	-	Any standalone equipment or process operation such as a pump in which all the logic for control of the equipment or process resides in the local installation.
27.	URT	-	Upset and Recovery Testing
28.	WFAT	-	Witnessed Factory Acceptance Tests

B. Reference Standards

The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature; define parameters of configuration and construction, in addition to specific details in this Section and the Contract Drawings:

1.	BWT PDS	-	BWT Design Guideline, Program Development Standards.
2.	BWT PLC	-	BWT Design Guideline, Programmable Logic Controllers.
3.	BWT SCADA	-	BWT Design Guideline, SCADA Software.
4.	ISA 5.1	-	Instrumentation Symbols and Identification
5.	ISA 5.2	-	Binary Logic Diagrams for Process Operations
6.	ISA 5.3	-	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
7.	ISA 5.4	-	Instrument Loop Diagrams.
8.	ISA 5.5	-	Graphic Symbols for Process Displays.
9.	ISA 18.1	-	Annunciator Sequences and Specifications.
10.	ISA 18.2	-	Management of Alarm Systems for Process Industries.
11.	ISA TR20.00.01	-	Specification Forms for Process Measurement and Control Instruments Part1: General Considerations.

12.	ISA 51.1	-	Process Instrumentation Terminology.
13.	ISA RP60.3	-	Human Engineering for Control Centers.
14.	ISA 101	-	Human Machine Interfaces for Process Automation Systems.
15.	NEMA 250	-	Enclosures for Electrical Equipment (1000 Volts Minimum).
16.	NEMA ICS 1	-	Industrial Control and Systems General Requirements.
17.	NEMA ICS 2	-	Industrial Control and System Controllers, Contactors and Overload Relays Rated 600V.
18.	NEMA ICS 4	-	Terminal Blocks.
19.	NFPA 79	-	Electrical Standard for Industrial Machinery.
20.	NYCEC	-	New York City Electrical Code.
21.	MIL-STD -1916	-	DOD Preferred Methods for Acceptance of Product.
22.	NYCEC	-	New York City Electrical Code.
23.	UL 508	-	Industrial Control Equipment.
24.	UL 1059	-	Terminal Blocks.

1.05 DESCRIPTION

A. The PMCS shall comply with the DEP's latest design guidelines for Wastewater Pumping Stations, Citywide Collection Facilities Integrated SCADA System (CCFISS), and the Contract Documents. The Contractor shall obtain the CCFISS contact information from the DEP Project Manager at the start of construction.

B. The system shall comprise of instruments, devices, hardware, software, programming, and coordination with other vendors specified in Division 40. PMCS shall include control panels specified in Section 40 67 16 – PMCS Panels and Enclosures with Attachment A and Section 28 23 10 - Video Surveillance, and interfacing with MSPCP specified in Section 43 23 31.05 – Vertical Centrifugal Pumping Units, and integrating the complete PMCS with the remote CCFISS.

C. Unit processes shall be fully capable of accomplishing control, monitoring, storing and logging equipment operation at local point.

D. Unit Processes shall have the ability to transfer control to remote Area Control points or a remote Central Control point.

E. The Contractor shall coordinate and collaborate with the suppliers and service engineers of the PMCS system that includes the following equipment and appurtenances listed in the various Divisions 28, 40, and 43 Sections:

1. MSP-1601, MSP-1602, MSP-1603, MSP-1604, MSP-1605 and MSP-1606 Main Sewage Pumps
2. VS-7401, VS-7402 and VS-7403 Vacuum Priming Systems
3. MSPCP-1600 – Main Sewage Pumps Control Panel
4. BSCP-9120 – Backup System Control Panel
5. PMCS-9110 – SCADA Panel
6. RTU-9130 – Telemetry Panel
7. EMCS-1510 – Electrical Monitoring and Control System
8. GMCP-8510 – Generator Monitoring and Control Panel
9. MCC-1A and MCC-1B – Motor Control Centers
10. VSS-8410 – Video Surveillance System
11. RTM-1 and RTM-2 – Real-Time Metering by DCAS
12. LAP-120 and LAP-140 – Local Alarm Panels for Hazardous Gases
13. All other field-mounted and panel-mounted instruments

F. Environmental Conditions:

1. The PMCS shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
    a. Control Rooms
        1) Ambient Temperature
            a) Normal Range 60º F to 80º F
            b) Extremes 40º F to 105º F.
        2) Relative Humidity
            a) Normal 80 percent
            b) Maximum 95 percent
    b. Indoor locations
        1) Ambient Temperature 40º F to 120º F.
        2) Relative Humidity 98 percent maximum.
    c. Outdoor locations
        1) Ambient Temperature -10º F to 120º F.
        2) Relative Humidity 100 percent maximum.

1.06 QUALITY ASSURANCE

A. Criteria

1. The PMCS facilities outlined in the Contract Documents and included herein have been designed to meet stringent quality standards. The criteria for selection of this system include, but are not limited to the following:
    a. The use of standard, "non-custom" equipment and application software.
    b. The ability of City's personnel to make modifications and adjustments in the field to react to actual field conditions.
    c. The ability of City to obtain training of City's personnel in a well-established equipment manufacturer training program.
    d. The availability of factory service and a well-stocked spare parts inventory, which could be drawn upon by the City in emergency situations.

B. PMCS Supplier

1. The PMCS shall be furnished by a single Supplier who shall assume responsibility for providing a complete and integrated system.
2. The system is to contain products of a single manufacturer, when possible, and to consist of equipment models, which are currently in production.
3. The Supplier shall identify those system components, which are not of his manufacture.
4. The Supplier shall supply his company's quality assurance plan, and for components which are not of his manufacture, the component manufacturer's quality assurance plan. The plans shall include but not necessarily be limited to:
    a. Method of testing, raw material criteria, methods of documentation, station control, "Burn-In", final tests and serialization coding and packaging.
    b. Plans should be in accordance with M.I.L.-STD-1916.

C. Supplier's Qualifications

1. Shall be a financially sound firm having at least ten (10) years continuous experience in designing, implementing, supplying and supporting instrumentation and control systems, which are comparable to the PMCS in terms of hardware, software, cost and complexity.
2. Shall have manufactured and supported standard lines of digital processing and control equipment and application software continuously for the last ten (10) years.
3. Shall have in existence at the time of bid advertisement, an experienced Engineering and Technical staff capable of designing, implementing, supplying and supporting the PMCS and handling the PMCS submittal and training requirements.

4. Shall provide system hardware components and software packages of fully developed, field proven standardized designs and therefore shall furnish a system which is not a highly unique, custom one-of-a-kind system.

5. Shall have a minimum of ten (10) years' experience in operator interface software configuration and hardware application and programming of distributed microprocessor based controllers and data highway systems.

6. Shall provide standard course offerings in general process control applications and in operation, programming and maintenance of the control system and equipment at a facility specifically utilized for training purposes. The facility shall have been in operation continuously for the last ten (10) years.

7. Shall have a thorough working knowledge of Pumping Station operation and control philosophy in accordance with standard practices of the industry.

8. Shall have a system of traceability of the manufactured units and purchased components through production, assembly and testing.

9. Shall have a system of "Burn-In" for all components and available supportive documentation.

10. Shall have a demonstrated record of prompt response to field failures.

11. Shall have a documented program of failure analysis.

12. Shall have a UL approved panel shop.

13. Shall have a record of prompt shipments in accordance with Contract obligations required for previous projects.

D. Technical Proposal Requirements

1. The Contractor shall submit a copy of a Technical Proposal from the Supplier which he has selected to provide the PMCS.

2. The Technical Proposal shall be complete and at a minimum contain all information as specified below:

a. Financial Statement

1) Shall include the value of PLC-based control systems delivered during the last five (5) fiscal years.

2) Shall include the value of other process instrumentation and controls shipped during the period.

b. Experience

1) Shall provide evidence of compliance with the specific experience requirements under the Supplier Qualification listed in this Section in the form of an experience certification signed by an officer of the company.

2) Shall furnish list of last ten (10) projects completed.

3) Shall describe at least three (3) completed municipal projects utilizing instrumentation and control equipment identical to or similar to (indicate which) that specified in this Section.

4) Shall indicate project name, value, completion date, names and phone numbers of representatives familiar with each project.

5) Letters of recommendation submitted does not relieve the Contractor from complying the requirements in this Section

c. Personnel

1) Shall provide a listing of those personnel committed to be assigned to the Contract.

2) List shall include Project Manager, Project Engineer, Field Representative, Local Service Representative, and Sales Representative.

3) Shall identify addresses of personnel not based at supplier's main office.

4) Shall provide documentation including resumes of personnel demonstrating experience in Pumping Station operations.

d. Exceptions

1) Shall list all exceptions and deviations from the requirements of the Contract.

2) Shall reference the Drawing Number, Section number, article, and paragraph of proposed variance and provide an explanation of why the proposed exception or deviation meets (or exceeds) the functional or equipment requirements specified.

e. Shipment Records

1) Shall provide evidence of timely delivery of equipment on past projects.

f. PMCS Hardware and Software:

1) Shall provide a general system configuration drawing and include designations for model numbers and types of the proposed distributed control system components and all other proposed system components.

2) Shall provide descriptive literature and manufacturer's catalog information covering all aspects of the hardware design and software functions and capabilities of the specific [discrete]/ [distributed] control system and data highway system proposed for the PMCS.

3) Shall provide descriptive literature and catalog information covering the features and capabilities of all proposed hardware components.

4) Shall describe standard software packages proposed, including any customized software required to meet the functional intent of the system Specifications.

5) Descriptions shall address the following:

a) Overview of system software including the functions, organization and interrelationship of the major software modules provided.

b) Estimated memory requirements to accomplish the specified graphic display, logging, reporting and alarming functional requirements.

c) Examples of graphic displays, methods of display access and procedures for display definition and generation, including use of the standard symbols library and capabilities for generating and storing user defined symbols in the symbol library.

d) Real-time data logging and reporting software features and capabilities including examples of logs and reports, procedures for automatic reporting and logging file setups, limitations on sampling and computing frequency for data acquisition and logging, and utilities for log file and report modifications and file maintenance.

e) Alarm handling software features and capabilities including an alarm display example, methods of defining alarms and alarm files, automatic printing of alarms, acknowledgements and return to normal conditions, chronological sorting and time-tagging of alarms, and alarm file maintenance utilities.

f) Distributed system programming and documentation software features and capabilities, including screen display and printout examples for a fully annotated and cross-referenced ladder diagram and the ladder diagram elements.

g) Use of system level diagnostics for monitoring the performance of and detecting and reporting faults associated with the distributed communications data highway.

g. Instrumentation and Panel Mounted Devices

1) The Contractor shall provide descriptive literature and catalog cuts for each type of sensor, transmitter, indicator, and other such devices required by the Contract.

h. Training

1) The Contractor shall provide information and literature as to the organization proposed and the factory facilities to be utilized for the training specified.

2) Indicate the qualifications of the factory training staff.

i. Availability Demonstration

1) The Contractor shall indicate how the Availability Demonstration will be accomplished.

j. Maintenance

1) The Contractor shall provide the following information:

a) Location of service facility along with minimum and maximum response time.

b) Location of parts facility with delivery time and method.

E. Supplier's Responsibility:

1. The Contractor shall retain the PMCS supplier to assume the responsibilities specified below. However, execution of these specified duties by the System Supplier shall not relieve the Contractor of the ultimate responsibility for the PMCS.

a. Design, fabrication, implementation and applications programming of the PMCS and all subsystems in accordance with the Contract Documents and all referenced standards and codes.

b. Preparation, assembly and correction of all PMCS submittals in accordance with the Contract Documents.

c. Proper interfacing of the PMCS hardware, software, field devices and panels, including required interfacing with packaged control systems furnished by other equipment suppliers, and with the Facility’s PMCS.

d. Supervision of the installation of PMCS, instruments, panels, consoles, cabinets, wiring and other components required.

e. Calibration, testing and start-up of the PMCS.

f. Training of The City personnel in operation and maintenance of the PMCS.

g. Handling of all warranty obligations for the control system components.

h. Maintenance of two (2) reproducible copies of the complete PMCS system and running software at the supplier's facility for the duration of the warranty period.

1) Software copies shall be maintained on the bulk storage medium used by the supplier for system program development and shall be directly loadable on the supplied system.

F. Coordination and Progress Meetings:

1. The Contractor shall be responsible for the scheduling and coordinating the system installation with regard to all other Work on the Site and in accordance with the provisions of the General Conditions. Said coordination shall be documented on the project schedule.

2. Routine progress and coordination meetings will be scheduled by Engineer. The Contractor and a representative of the System Supplier shall be required to attend a minimum of one meeting per month for the length of Contract.

3. The purpose of the meetings shall be to review the progress of the Work involving the PMCS and provide coordination for installation of the equipment to ensure construction schedules are met.

4. Representatives at the meetings shall have the competence and authority to make any and all necessary decisions. Decisions and statements made at the meetings shall commit the Contractor and the System Supplier to agreed procedures and schedules.

G. System Supplier Project Personnel

1. The Contractor shall require the System Supplier to provide the following project personnel:

a. Project Manager

1) The System Supplier shall appoint a Project Manager who shall coordinate and schedule all work and assure that the Contract schedule is met.

2) The Project Manager shall have a minimum of ten (10) years' experience in coordination, scheduling and delivery of instrumentation and control contracts under similar Pumping Station Facilities as this Contract thorough working knowledge of contract administration as both a prime and sub-prime Vendor/Contractor.

3) The Project Manager shall act as the liaison with the Contractor for the installation of the PMCS and shall assist in all matters required for proper coordination and interfacing of the equipment and processes.

b. Field Engineer

1) The System Supplier shall appoint a Field Engineer with responsibilities as follows:

a) Provide advice and technical consultation relative to installation techniques and procedures for equipment furnished.

b) Installed system checkout, calibration, adjustment and start-up including tuning of every control loop.

c) Maintenance services during availability demonstration.

d) Involvement in the on-site system training of pumping station personnel.

e) Resolving of control problems encountered during initial start-up and testing of all PMCS monitoring equipment.

2) The Field Engineer shall have a minimum of ten (10) years' experience in systems engineering and start-up and shall have a thorough working knowledge of both the hardware and software supplied for the PMCS.

c. Training Personnel:

1) Comply with requirements of Section 40 61 26 - PMCS Training.

1.07 SUBMITTALS

A. Shop Drawings General

1. The Contractor shall submit Shop Drawing and material specifications for the approval of the Engineer.

2. Shop Drawing preparation shall not commence until after the pre-submittal conference specified below.

3. Manufacture of the PMCS shall not commence until related and interfacing equipment submittals have been approved by the Engineer.

4. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in this Section under Submittal Requirements.

5. Review of Shop Drawings will be for conformance with Contract Documents and with regard to functions specified to be provided.

B. Pre-Submittal Conference

1. The Contractor shall arrange and conduct a pre-submittal conference on the PMCS within forty-five (45) days of notification of preliminary acceptance of the proposed PMCS and Supplier by the City and the Engineer.

2. The Pre-submittal conference shall be attended by representatives of Contractor, the PMCS Supplier, and the Engineer. The Contractor shall allocate one (1) full working day for the conference and that time shall be included in the price of this Contract. The meeting shall be held at the Pumping Station or location approved by the Engineer.

3. The purpose of the pre-submittal conference shall be to review informally and approve the manner in which the control system supplier intends to respond to the Contract requirements before any submittals are prepared.

4. Contractor shall prepare the items listed below for presentation at the pre-submittal conference. The information shall be submitted to Engineer four (4) working weeks prior to the date of the conference.

   a. List of equipment and materials required for the PMCS and the brand and model which Contractor proposes to use for each item or component of the proposed system.

   b. List of proposed exceptions to the plans and specifications along with a brief explanation of each.

      1) Approval of exceptions and substitution shall be subject to a formal submittal according to the Contract procedure.

   c. Sample of each type of submittal specified herein. These may be submittals prepared for other projects.

   d. A flow chart showing the steps to be taken in preparing and coordinating each control system submittal to the Engineer, and a list of proposed submittals.

   e. Schedule for all PMCS related activities from the pre-submittal conference through start-up and training.

      1) Particular emphasis shall be given to dates relative to submittal, design, fabrication, programming, factory testing, delivery, installation and field testing.

      2) The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

      3) Schedule shall conform to requirements for Contract schedules.

   f. General outline of the type of tests to be performed to verify that the PMCS and all its components including sensors/transducers, instruments and digital processing equipment are functioning properly.

C. Sensors/Transducers and Panel Instruments.

1. Submit product information for all sensors/transducers and panel instruments. Include the following:

a. Manufacturer's product name and model number.

b. Instrument tag number from Contract Documents.

c. Manufacturers' standard catalog product data.

d. Description of construction features.

e. Performance and operation data.

f. Installation and mounting details, instructions and recommendations.

g. Service requirements.

h. Dimensions.

D. PMCS Information:

1. System Description

a. Detailed block diagram showing system hardware configuration and identifying model numbers of system components.

b. Software language and organization:

1) Format, protocol and procedures for data highway communications and local communications with input/output modules and peripheral devices.

2. HMI details:

a. Control and failure modes;

b. On line and off line capabilities for programming, system utilities and diagnostics;

c. Input/output point listing with I/O module cross reference identification for each distributed controller;

d. Data base listing including all input/output points;

e. Suggested detailed format and configuration of all log reports, alarm summaries, printer outputs, displays and graphics;

f. List of spare parts and test equipment.

3. Equipment Hardware

a. Layout drawings showing front, rear, end and plan views to scale of all processing equipment, I/O components, power supplies and peripheral devices.

b. Construction details, features and procedures.

c. Interconnection diagrams including termination details, cable identification list and cable length.

d. Plans showing equipment layout in control panels.

e. Installation requirements, instructions and/or recommendations

4. Software Description

a. Standard technical documentation covering all aspects of the PMCS software functions and capabilities, including instruction set description and programming procedures related to control, monitoring, display, logging, reporting and alarming functions

b. Standard technical and instructional documentation covering software for utility, system support, system documentation, display, communications, data logging and storage and diagnostic functions.

c. Detailed functional descriptions of application programs explaining control, display, logging and alarming features to be provided and functions to be performed.

d. Documentation describing memory type, size and structure and listing size of system memory, I/O and data table memory and size of memory available for control programs. Also define estimated control program memory requirements and processor execution times and program scan times.

e. Documentation describing central monitoring station main and secondary memory type size and requirements to perform the display, logging, reporting and alarming functions required.

5. Panels, Consoles and Cabinets Information:

a. Layout Drawings shall include the following:

1) Front, rear, side, end and plan views to scale.

2) Dimensional information

3) Tag number and functional name of components mounted in and on panel, console or cabinet.

4) Product information on all panel components.

5) Nameplate location and legend including text, letter-size and colors to be used.

6) Location of anchoring connections and holes.

7) Location of external wiring and/or piping connections.

8) Mounting and installation details.

9) Proposed layouts and sizes of graphic display panels.

10) Calculations for heating and cooling.

b. Wiring and/or piping diagrams shall include the following:

1) Name of panel, console or cabinet.

2) Wiring sizes and types.

3) Piping sizes and types.

4) Terminal strip numbers.
5) Color coding
6) Functional name and manufacturer's designation for components to which wiring and piping are connected

c. Electrical control schematics in accordance with NFPA 79.

d. Plan showing equipment layout in each area.

6. Field piping diagrams shall include the following:

a. Piping sizes and types.

b. Location, functional name and manufacturer's designation of items to which piping is connected.

7. Instrument loop diagrams for all analog display, control and I/O loops prepared using ISA standard symbols in accordance with ISA 5.4 shall include the following:

a. Instrument tag numbers from Contract Documents.

b. Functional name of each item

c. Manufacturer's model, product, or catalog number for each item.

d. Location of each item

8. ISA Data Sheets:

a. ISA Data Sheets shall comply with ISA–TR20.00.01–2001 requirements and shall be computer generated.

b. All field and panel instruments ISA Data Sheets shall contain the following information, as a minimum.

1) Tag number in accordance with Section 40 61 94 – Pump Monitor and Control System Instrument Index and Contract Drawings;
2) Product (item) name used herein and on the Contract Drawings;
3) Name of manufacturer or supplier;
4) Manufacturer's complete model number;
5) Location of the device;
6) Input-output characteristics;
7) Range, size, and graduations;
8) Physical size with dimensions, NEMA enclosure classification and mounting details;
9) Materials of construction of all components;
10) Instrument or control device sizing calculations, where applicable;

11) Certified calibration data on all flow metering devices, where applicable;

12) Environmental requirements during storage and operation.

9. PMCS I/O Loop Wiring Diagrams

a. Contractor shall prepare drawings on a module-by-module basis and include the following information:

1) Rack numbers, slot number, module type and module terminal point numbers. Also, include location and identification of all intermediate panel terminal block and strip numbers to which I/O wiring and power supply wiring is connected. Identify all power supply circuit numbers and ratings.

2) Wiring sizes, types, wire numbers and color-coding.

3) Location, functional name, tag numbers and manufacturer model numbers of panel and field devices and instruments to which I/O wiring is connected. For discrete I/O devices, use JIC electrical symbols tagged with designation shown on P&IDs.

E. PMCS Operation and Maintenance (O&M) Manuals

1. The Contractor shall furnish O&M manuals for the PMCS in accordance with the Section 01 78 25 – Operations and Maintenance Manuals, this Section and the following minimum requirements:

a. Name, address and telephone number of the PMCS Supplier’s local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of all approved submittal information and system shop drawings as specified herein with corrections made to reflect actual system as tested and delivered to the site for installation.

d. Half-size black line reproductions shall be provided for all shop drawings larger than 11 by 17 inches.

e. All drawings shall be 11 by 17 inches minimum size.

1) Drawings 8-1/2 by 11 inches are not acceptable.

f. Manufacturer's Original Copies of Hardware, Software and Installation, Assembly and Operations Manuals for the PMCS central monitoring station and peripheral devices, and all other control system components.

g. Manuals shall include the following information:

1) General descriptive information covering the basic features of the equipment
2) Physical description covering layout and installation requirements and all environmental constraints.
3) Functional and operational descriptions covering the procedures for programming, operation, start-up, shutdown, and calibration of the distributed control system equipment and explaining how the various control functions are performed.
4) Principles of operation explaining the logic of operation; provide information covering operation to a component level.
5) Maintenance procedures covering checkout, troubleshooting, and servicing.
    a) Checkout procedures shall provide the means to verify the satisfactory operation of equipment,
    b) Troubleshooting procedures shall serve as a guide in determining faulty components and
    c) Servicing procedure shall cover requirements and recommended time schedule for calibration, cleaning, lubrication and other housekeeping and preventive maintenance procedures.
6) Wiring, schematic and logic diagrams.
7) Safety considerations relating to operation and maintenance procedures.

F. Record Drawings and Documentation

1. The Contractor shall require the System supplier to revise all system shop drawings, submittals and software documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents and the supplemental requirements.
2. All revised shop drawings and documentation shall be submitted to the Engineer per Section 01 78 40 – Records in Paper Formats to replace outdated drawings and documentation contained in the system O&M Manuals.
3. Half-size black line sets shall be provided for all drawings larger than 11 x 17. Specific instructions for outdated drawing removal and replacement shall be provided with the record drawing submittal.
4. Half-size black line prints of wiring diagrams applicable to each control panel shall be provided inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

G. Reports:

1. The following report shall be submitted shall be submitted to the Engineer:
    a. Factory Test Reports as specified in Section 40 80 81 - PMCS Factory Testing.
    b. Installation Inspection, Field Calibration, and Field Testing. Reports, as specified in Section 40 80 82 - PMCS Startup and Field Testing.
    c. Training as specified in Section 40 61 26 – PMCS Training.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The PMCS equipment shall be delivered, stored and handled in accordance with the Sections listed under Related Section of this Section, the Contract Documents, the manufacturer's recommendations, and the following:

1. PMCS equipment shall be packaged at the factory prior to shipment to site, to protect each item from damage during shipment and storage.
2. Containers shall be protected against impact, abrasion, corrosion, discoloration and/or other damages.
3. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment.
4. PMCS equipment shall be inspected for shipping damage or loose parts when received.
5. Evidence of water which may have entered equipment during transit shall be checked.
6. PMCS equipment shall be lifted, rolled or jacked into locations shown on the Contract Drawings.
7. PMCS equipment shall be stored in a clean, dry location in which a uniform temperature is maintained.
8. PMCS equipment shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment is kept dry and free from condensation.
9. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the PMCS in accordance with the Sections listed under Related Sections of this Section.

B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS/s shall be as manufactured by:

1. Xylem/Flygt/G.A. Fleet, Rye Brook, NY
2. Optimum Controls Corp, Reading, PA;
3. Siemens Industry Inc., Washington, DC;
4. A.K. De Rama Industrial Control System Inc., Mountainside, NJ;
5. AVANTech, LLC, Columbia, SC;
6. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Design Criteria

1. Power Supplies:

a. All electrically powered equipment and devices shall be suitable for operation on 115-volt +/- 10 percent, 60 Hz. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided.

b. Appropriate power supplies shall be furnished by the Contractor for all two (2) wire transmitters, loops for monitoring discrete inputs and all necessary outputs.

c. Power supplies shall be mounted in enclosures and installed in the appropriate indoor or field panel.

d. Power supplies shall be sized adequately for signal converter and repeater loads.

e. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.

f. A power on-off switch or an air circuit breaker shall be furnished for each item requiring electrical power.

g. Provide isolation transformers, line voltage regulators and power distribution panels for the distributed digital portions of the PMCS to eliminate electrical noise and/or transients entering on the primary power line.

2. Signal Requirements

   a. The control system shall be designed to use 4 to 20 mA DC analog signals, unless otherwise specified.

   b. Signal converters and repeaters shall be provided where required and in addition analog inputs to the distributed control system shall be through appropriate repeaters to provide signal isolation where series looped with other devices and to allow the loop to maintain integrity even if the distributed control system is out of service.

   c. Signals shall be isolated from ground.

   d. Signals shall not have a transient dc voltage exceeding 300 volts over one millisecond nor a dc component over 300 volts.

   e. Equipment ranges, scales and set-point values specified in Division 40 and as shown on the P&IDs are for initial setting and configuration. Contractor shall coordinate these values with actual equipment furnished to implement proper and stable process action as systems are placed in operation.

   f. For any items where ranges, scales and set-points may not have been specified, Contractor shall submit a recommendation to the Engineer for review and approval.

   g. Design all logic and control loops for fail-safe operation.

   h. Surge protection shall be provided for all PMCS and all other control system components which could be damaged by electrical surges.

   i. The system and associated input/output wiring will be used in a Pumping Station environment where there can be high energy ac fields, dc control pulses, and varying ground potentials between the sensors/transducers or input contact locations and the system components. The system design shall be adequate to provide proper protection against interference from all such possible situations.

B. Miscellaneous:

1. All PMCS components shall be heavy-duty types, designed for continuous service in a Pumping Station environment.

2. All equipment provided are to be of Modular construction and to be capable of field expansion through the installation of plug-in circuit cards and additional cabinets as necessary.

3. All instrumentation and PMCS components shall be designed to return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure or when transferred to standby power supply.

4. All field-mounted instruments and system components shall be designed for installation in humid and corrosive service conditions.

5. All field mounted cabinets, instrument enclosures, junction boxes and appurtenances shall conform to NEMA 4X requirements and be made of 12 gage Type 316 stainless steel, unless otherwise specified.

6. All relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.

7. All panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. All panel door mounted devices shall be of the same manufacturer and model line.

8. All components furnished, including field and rear of panel instruments, shall be tagged with the item number and nomenclature indicated on the Contract Documents and/or approved Shop Drawings.

9. Field-mounted devices shall be treated with an anti-fungus spray.

10. Field-mounted devices shall be protected from exposure to freezing temperatures.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Control Strategies

1. Functional descriptions of all monitoring and control sequences for the PMCS shall be as specified in Section 40 61 96 - PMCS Control Strategies.

2. The general guidance on how the control strategies shall be implemented in the PMCS shall be as specified in Section 40 61 95 – PMCS Monitoring and Control Criteria.

B. HMIs

1. HMIs, PPU and other display panels used for the monitoring and control of Unit Processes and equipment shall be as specified in Section 40 63 43 - PMCS Programmable Logic Controllers.

C. PLCs

1. Programmable Logic Controllers for the PMCS shall be as specified in Section 40 63 43 - PMCS Programmable Logic Controllers.

D. Telemetry

1. Telemetry and similar remote monitoring and control equipment for the PMCS shall comply with NYC DEP requirements for Citywide Collection Facilities Integrated SCADA System (CCFISS).

2. Contractor shall coordinate with DCAS and its installer NuEnergen on the installation of real-time metering (RTM). The Contractor shall allow

DCAS and NuEnergen personnel to access the facility and electrical equipment, including Con Edison metering equipment for connecting the RTMs. Contractor shall provide a 120-Volt outlet and data port for each RTM as shown on the Contract Drawings.

E. Panels and Enclosures

1. Panels and Enclosure for the PMCS shall be as specified in Section 40 67 16 - PMCS Panels and Enclosures.

F. HMI Software

1. HMI Software for HMIs and laptops for the PMCS shall be as specified in Section 40 63 43 - PMCS Programmable Logic Controllers.

G. Panel Mounted and Field Instruments

1. Instruments and Devices installed on panels and in the field for the PMCS shall be as specified in Section 40 78 90 - PMCS Panel Mounted Instruments and Devices.
2. Standalone instruments and devices for the PMCS shall be as specified in Section 40 79 91 - PMCS Field Instruments

H. Lists and Index

1. PMCS I/O shall be as specified in Section 40 61 93 – PMCS Input Output List
2. The list of instruments, their ranges, Tag Numbers, and P&ID shall be as specified in Section 40 61 94 – PMCS Instrument Index.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Factory Tests

1. Factory testing for the PMCS shall be as specified in Section 40 80 81 – PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Field Testing for the PMCS shall be as specified in Section 40 80 82 – PMCS Startup and Field Testing

B. Training

1. Training on the operation and Maintenance of the PMCS shall be as specified in Section 40 61 26 – PMCS Training.

3.04 STARTUP / DEMONSTRATION

A. Operational Availability

1. The system test and Operational availability of the PMCS shall be as specified in Section 40 80 82 – PMCS Startup and Field Testing.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 61 26 – PMCS TRAINING
CONTRACTPS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and coordinate all required training at times acceptable to the City and the Engineer. The term "PMCS" shall include all control panels provided by the PMCS Supplier and other Suppliers for equipment and appurtenances listed in Section 40 61 13 – PMCS General Requirements.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Application	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	8

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 75 10 - Preliminary and Final Field Tests

B. Section 01 79 05 - Equipment Start-up and Training

C. Section 40 61 13 - PMCS General Requirements

1.04 REFERENCES

A. Definitions

1. Section 40 61 13 – PMCS General Requirements defines the terms abbreviations used in this Section and the PMCS

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to the PMCS.

1.05 DESCRIPTION

A. General

1. The Contractor shall retain the services of the PMCS Supplier to provide and perform standardized, structured training courses on site and off site, as specified in this Section, and the Contract Documents covering both operation and maintenance of the PMCS equipment.

2. On-Site Training

a. On-Site training shall be within the Pumping Station where the PMCS will be installed.

b. On-site training shall make extensive use of the installed PMCS to ensure Pumping Station personnel develop an enhanced understanding and level of comfort with the PMCS.

c. On-site training submittals which in the opinion of the Engineer does not meet the objectives stated in this Section and the Contract Documents shall be rejected.

3. Off-site Training

a. Off-site training shall be conducted at an approved facility within a 10-mile radius of the Contract site.

b. The training facility shall be staffed with regular full-time training instructors.

c. If the PMCS Supplier does not have a training facility with a ten-mile radius of the Contract Site a suitable facility shall be rented.

d. Off-site training submittals which in the opinion of the Engineer does not meet the objectives stated in this Section and the Contract Documents shall be rejected.

4. All training, except Follow-up Training specified in this Section, shall be scheduled so that it is completed prior to Acceptance of the PMCS by the City.

5. The City will send the following personnel to attend training courses:

a. Operations Training – 4 persons

b. Maintenance Training - 4 persons

c. Supervisor Training - 2 persons

d. Engineer Training - 2 persons

6. All training shall be conducted during the hours of 8:00 AM to 5:00 PM until the conclusion of the training course.

7. All training sessions shall be provided twice and shall be scheduled by the City to accommodate their shift schedule.

1.06 QUALITY ASSURANCE

A. General:

1. For equipment items not manufactured by the PMCS Supplier, the PMCS Supplier shall provide training by an authorized representative of the equipment manufacturer as part of PMCS Supplier services.

2. The manufacturer’s representative shall be fully knowledgeable in the operation and maintenance of the equipment.

B. PMCS Supplier's Training Qualifications

1. Section 40 61 13 – PMCS General Requirements specifies the PMCS Supplier’s training qualifications.

C. PMCS Supplier's Training Responsibility:

1. Section 40 61 13 – PMCS General Requirements specifies the PMCS Supplier’s training responsibility.

D. PMCS Supplier Training Personnel

1. The Contractor shall require the System Supplier to provide the following training personnel:

a. Lead Trainer

1) The System Supplier shall appoint a Lead Trainer who shall coordinate, schedule and conduct all work and assure that the Training schedule is met.

2) The Lead Trainer shall have a minimum of ten (10) years’ experience in coordination, scheduling and delivery of instrumentation and control training at/under similar Pumping Station Facilities as this Contract including a thorough working knowledge of training administration as both a prime and sub-prime Vendor/Contractor.

3) The Lead Trainer shall be the PMCS Supplier’s liaison with the Contractor for all PMCS training requirements and shall assist in all matters required for proper coordination and interfacing of the training with the City.

1.07 SUBMITTALS

A. Shop Drawings General

1. Within 90 days of the effective Notice to Proceed, the Contractor shall submit for approval of the Engineer, Shop Drawings detailing the proposed plan for training, including but not limited to all course outlines and schedules.

2. Shop Drawing preparation shall not commence until after the pre-submittal specified in Section 40 61 13 – PMCS General Requirements.

3. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in this Section.

B. Reports:

1. Training reports shall be submitted to the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The PMCS training equipment and materials shall be delivered, stored and handled in accordance with this Section, the Contract Documents, the PMCS Supplier's recommendations and the following:

1. PMCS training equipment and material shall be packaged to protect each item from damage during shipment and storage.

2. Containers shall be protected against impact, abrasion, corrosion, discoloration and/or other damages.

3. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment and materials.

4. PMCS training equipment and materials shall be inspected for shipping damage or loose parts when received.

5. Evidence of water which may have entered equipment during transit shall be checked.

6. PMCS training equipment and materials shall be stored in a clean dry location in which a uniform temperature is maintained.

7. PMCS training equipment and materials shall be protected in storage with suitable covering and air circulation maintained to ensure the equipment and materials are kept dry and free from condensation.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS Training shall be as delivered by the approved PMCS Supplier.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Training of Pumping Station Personnel

1. Operator Training

a. Provide a course covering the structure and the functions of the PMCS, its components and devices. Minimum course duration shall be 2 days, 8 hours per day.

b. The course shall familiarize the Operator with the procedures for applying the PMCS to process control situations or scenarios and develop operator issue resolution capability.

c. As a minimum, the course shall cover the following topics:

1) Overview of PMCS functional capabilities.

2) Equipment overview including PMCS component functions, operating principles and proper use.

3) Loading and start-up of the digital system hardware components.

4) Use of PMCS commands.

5) Development of programs and control schemes.

6) Development and use of system displays.

7) Programming concepts and techniques.

8) Use of bulk storage device for system backup.

2. Maintenance Training Course:

a. Provide 2 days, 8 hours per day course covering preventive and troubleshooting maintenance for the PMCS components.

b. The course shall familiarize the maintenance personnel with diagnostic capabilities of the system, both software and hardware, and also the routine maintenance procedures on the system and the common peripheral devices.

c. As a minimum the course shall cover the following topics:

1) PMCS overview description including the power subsystems and logic components of the processor bus.

2) Description of the maintenance and troubleshooting aids of the system including software diagnostic programs.

3) Description of all bus operations.

4) Description of peripheral and process interface devices.

5) The use of hardware diagnostic routines, test equipment and test procedures as required to enable the City's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.

3. Supervisor/Engineer Training

a. Provide 4 days, 8 hours per day manufacturer's standard training in the use and configuration of the PMCS HMI software.

b. An instructor certified by the software manufacturer to furnish such training shall perform this training.

c. The course shall be structured as follows:

1) Fundamentals

a) One two-day course (minimum) shall be provided which shall serve as a PMCS familiarization course for Project management personnel, engineers, and key operating/maintenance personnel.

b) This course shall be a prerequisite for the advanced course.

2) Advanced

a) One three-day (minimum) PMCS configuration and operating course shall be provided.

b) The level of training shall be sufficient to familiarize the City personnel with the configuration and application of all PMCS programs.

c) All essential system operating procedures shall be described as required to enable the City personnel to operate and configure the PMCS via all interfaces such as Work Stations, Large Display Screens and local control panels.

d. Upon completion of the training the City personnel shall be able to make modification to Control Strategies and have them run in the PMCS.

e. Training shall be provided in the following subjects:

1)

2) The following are sample subjects:

a) System overview and capabilities

b) Database configuration

c) Graphic display configuration, including linking of data to displays

d) Historical data configuration (collection, manipulation, and display)

e) Real-time and historical trending

f) Report configuration, generation, printing, and customization

g) System security

h) I/O driver and configuration

i) System back-up and recovery

j) Dynamic Data Exchange (DDE) linking, where applicable

k) System command language

l) Troubleshooting

m) System optimization

n) System start-up and shutdown procedures

o) Communications with remote DEP facilities.

B. Follow-up Training

1. The PMCS Supplier shall provide operation and maintenance training covering all PMCS equipment provided.

2. The Follow-up Training shall take place 12months after Acceptance of the PMCS by the City.
3. The Follow-up Training shall repeat the On-Site Training specified in this Section.
4. The Follow-up Training shall in addition, target those areas of PMCS equipment where Pumping Station personnel have highlighted either operational or maintenance issues.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 61 93 – INPUT/OUTPUT LIST
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the I/O point list and requirements for configuring the PMCS databases.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Application	5
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

C. The I/O List information is provided in Table 1, attached after the End of Section designation.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

1.04 REFERENCES

A. Definitions

1. I/O – Input/Output
2. SFT – Start-up and Field Testing.
3. OAD – Operational Availability Demonstration.
4. URT – Upset and Recovery Testing.
5. WFAT - Witnessed Factory Acceptance Tests.
6. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. General

1. The I/O point list shall be used to configure the I/O interface hardware of all controllers of the PMCS.
2. The listing includes information on signal functions, signal ranges and range conversions.
3. As a minimum, the Contractor shall provide all hardware and software to provide the I/O points listed in the accompanying I/O List as indicated in the Contract Documents and as required.
4. The Contractor shall furnish and install as spares, twenty-five (25) percent of each type of I/O of the listed I/O point hardware.
5. The Contractor shall furnish and install spare hardware and fully configure all spare points into the PMCS databases, displays, trends, alarms and controllers.
6. All I/O points designated as spares shall be completely prewired to equipment and panel terminal blocks such that only field connections need to be complete when the I/O is activated.

B. I/O List Column Headings

1. NO or Ref NO or Item NO – is a sequential number starting with a discrete number used to order the entries in the I/O List and permitting the list to sorted and resorted to its original order.
2. [TAG NUMBER – is an alpha numeric character string used to identify the I/O point and laid out as follows ISA_###_Y where
   a. ISA – is the functional identifier of the I/O and follows ISA 5.1.
      1) ISA identifiers will be provided with the I/O Lists.
   b. ### - is a 3-digit number identifying the loop or field device.

c. Y – is a digit or letter identifying duplicate instruments or devices on the same loop.

3. I/O Type is a two letter describing the I/O as follows:

a. AI designates an analog input (4 to 20 mA DC)

b. AO designates an analog output (4 to 20 mA DC)

c. DI designates a discrete input

d. DO designates a momentary, maintained or latched discrete output.

e. LAN designates Local Area Network for data communications between devices within the pumping station

a. WAN designates Wide Area Network for data communications between the pumping station and a remote facility such as CCFISS or other DEP facility.

4. INSTRUMENT TYPE – is an alphanumeric string up 30 positions describing the signal attribute of the point such as:

a. Flow Indicating Transmitter

b. Limit Switch Open

c. Solenoid Valve

5. SERVICE – is an alphanumeric string up 30 positions describing the equipment where the signal is located.

6. P&ID NUMBR – is the listing of the P&ID Drawing where the I/O point can be found.

7. LOCATION – is the listing of the physical location of the instrument or device generating the I/O Point

8. RANGE – is the range of the I/O in engineering units.

9. REMARKS – can be used for supplementary information or to cross-reference information.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. The Contractor shall not commence production of database until the configuration of all I/O points has been approved by the Engineer.

C. For each I/O attribute listed in the I/O list which cannot be used exactly as listed, submit an explanation of the reason for the deviation and propose a method to modify the I/O list information.

D. I/O information specific to all controllers shall in addition be submitted with the submittal covering that controller.

E. I/O Lists shall be kept current, updated regularly and shall be available for inspection by the City at the Project Site.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit all I/O lists and schedules for the approval of the Engineer.

C. The Contractor is solely responsible for the timing of I/O listing submittal to enable approval by the Engineer and subsequent use by the PMCS Supplier.

D. The Contractor shall create, maintain and submit for review, an updated I/O Listing of all device, instruments and I/O points.

E. Submittal shall be made at least 60 days in advance of any proposed use by the PMCS Supplier.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS I/O Lists shall be implemented by the PMCS Supplier.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS Factory Test shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. Section 40 80 81 - PMCS Factory Testing details how the configuration of I/O specified under this Section shall be verified against approved submittals.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 APPLICATION

A. I/O Configuration

1. Implement the control system database fields in a consistent manner by using the following procedures:

    a. Use abbreviations and acronyms already established in the Contract Documents.

    b. In particular use the information in the I/O List.

    c. Use only abbreviation or acronym for a word or group of words respectively.

    d. Use the same subject and word order within data fields.

    e. Use the same term (either phrase, word or acronym) to denote the same meaning.

    f. Do not use multiple terms for a single meaning.

    g. Use the point names, descriptions, logic state descriptions, ranges and units of measurement exactly wherever the point is referenced.

    h. Show point names and descriptions for all point references on documentation.

    i. Spell correctly.

    j. Maintain lists of acronyms and abbreviations used.

B. I/O Hardware Configuration

1. Partition the I/O among cards within an I/O enclosure to provide control loop integrity.

    a. Put all inputs of the same I/O type associated with a device (e.g. pump, blower, clarifier or other piece of equipment) on the same card.

    b. Put all inputs of the same I/O type for devices arranged in process trains (e.g. a pump, its inlet valve and its outlet valve, or a pump and its associated macerator) on the same card or cards if more than one card is needed to accommodate the points.

    c. Put all outputs of the same I/O type associated with a device or group of devices in a process train on the same card.

    d. Where the preceding requirements specified in this subparagraph would cause more than 20 percent spare points on a card, points

for a device or process train may be split between two consecutive cards.

e. Make unused terminals resulting from partitioning the I/O into pre-wired spares.

f. Provide pre-wired spare points with all cabling and termination internal to controllers as done for other I/O points.

C. Spares Utilization

1. If I/O is added by change order, incorporate pre-wired spare points into the active point data base at no increase in Contract price.

a. Include changing point names, descriptions, ranges, or statuses from spare to the new point.

b. Include adding points to group displays and summary displays.

c. Include related documentation changes.

2. Spares utilization will be subject to the following limitations:

a. The incorporation will not alter the control software configuration except to make the point accessible to displays, reports and future control software configuration.

b. The incorporation will not alter the local area panels or field wiring to the device.

c. Additions will not increase the size of reports or number of displays beyond that specified.

d. The change will not be made subsequent to the controller shop drawing approval for a given process area.

3. Treat changing of active points to spare points in the same manner as incorporation of spares.

D. Point Data Fields

1. I/O point data fields will be subject to review and modification by the Engineer during the shop drawing review phase.

2. Incorporate changes directed by the Engineer completely into the entire system at no increase in Contract price subject to the following limitations:

3. Limit the total number of modifications to 20 percent of the total number of I/O points.

4. Each unique change will count as one modification. For example, modifying the description, range, and engineering unit on an analog input count as 3 modifications.

5. Analog input alarm limit definition will not be counted as a modification.

3.03 FIELD TESTING / QUALITY CONTROL

A. PMCS Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. Section 40 80 82 details how the configuration of I/O specified under this Section shall be verified during Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the configuration of all PMCS I/O.

C. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

See Attached Tables:
Table 1 – Input/Output List – MSPCP-1600
Table 2 – Input/Output List – PMCS-9110
Table 3 – Input/Output List – RTU-9130

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Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
1	ECI-1601	AI	RVSS/BPS	MSP-1601 Control Voltage	I-104	MSPCP-1600	0-150 V	
2	ECI-1602	AI	RVSS/BPS	MSP-1602 Control Voltage	I-104	MSPCP-1600	0-150 V	
3	ECI-1603	AI	RVSS/BPS	MSP-1603 Control Voltage	I-104	MSPCP-1600	0-150 V	
4	ECI-1604	AI	RVSS/BPS	MSP-1604 Control Voltage	I-105	MSPCP-1600	0-150 V	
5	ECI-1605	AI	RVSS/BPS	MSP-1605 Control Voltage	I-105	MSPCP-1600	0-150 V	
6	ECI-1606	AI	RVSS/BPS	MSP-1606 Control Voltage	I-105	MSPCP-1600	0-150 V	
7	LIR-027	AI	LIT-027	Wet Well Level Primary	I-103	MSPCP-1600	0-14 feet	
8	LIR-028	AI	LIT-028	Wet Well Level Secondary	I-103	MSPCP-1600	0-14 feet	
9	PIR-1601	AI	PIT-1601	MSP-1601 Discharge Pressure	I-104	MSPCP-1600	0-15 psi	
10	PIR-1602	AI	PIT-1602	MSP-1602 Discharge Pressure	I-104	MSPCP-1600	0-15 psi	
11	PIR-1603	AI	PIT-1603	MSP-1603 Discharge Pressure	I-104	MSPCP-1600	0-15 psi	
12	PIR-1604	AI	PIT-1604	MSP-1604 Discharge Pressure	I-105	MSPCP-1600	0-15 psi	
13	PIR-1605	AI	PIT-1605	MSP-1605 Discharge Pressure	I-105	MSPCP-1600	0-15 psi	
14	PIR-1606	AI	PIT-1606	MSP-1606 Discharge Pressure	I-105	MSPCP-1600	0-15 psi	
15	HC-026	*	BSCP Lev Sel	Level System Selector Primary/Secondary	I-103	MSPCP-1600		
16	HC-029A	DI	BSCP Seq Sel	MSP Sequence Selector Position A	I-103	MSPCP-1600		
17	HC-029B	DI	BSCP Seq Sel	MSP Sequence Selector Position B	I-103	MSPCP-1600		
18	HC-029C	DI	BSCP Seq Sel	MSP Sequence Selector Position C	I-103	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
19	HC-029D	DI	BSCP Seq Sel	MSP Sequence Selector Position D	I-103	MSPCP-1600		
20	QA-030	DI	BSCP Mode Sel	Backup System Not in Auto	I-103	MSPCP-1600		
21	QI-030	DI	BSCP Relay	Backup System Active	I-103	MSPCP-1600		
22	LAH-026	LAN	PMCS-9110	Ralph Avenue Sewer Flow High Alarm	I-103	MSPCP-1600		
23	LAHH-027	*	LIT-027	Primary Level High-High Alarm	I-103	MSPCP-1600		
24	LAHH-028	*	LIT-028	Secondary Level High-High Alarm	I-103	MSPCP-1600		
25	LALL-027	*	LIT-027	Primary Level Low-Low Alarm	I-103	MSPCP-1600		
26	LALL-028	*	LIT-028	Secondary Level Low-Low Alarm	I-103	MSPCP-1600		
27	LAH-027	*	LIT-027	Primary Level High Alarm	I-103	MSPCP-1600		
28	LAH-028	*	LIT-028	Secondary Level High Alarm	I-103	MSPCP-1600		
29	LAL-027	*	LIT-027	Primary Level Low Alarm	I-103	MSPCP-1600		
30	LAL-028	*	LIT-028	Secondary Level Low Alarm	I-103	MSPCP-1600		
31	QI-1601P	DI	LS-1601P	MSP-1601 Proof of Prime	I-104	MSPCP-1600		
32	QI-1602P	DI	LS-1602P	MSP-1602 Proof of Prime	I-104	MSPCP-1600		
33	QI-1603P	DI	LS-1603P	MSP-1603 Proof of Prime	I-104	MSPCP-1600		
34	XA-7401	DI	LCP-7401-C	Vacuum Primer VP-7401 PLC Failure	I-106	MSPCP-1600		
35	VAL-7401	DI	LCP-7401-C	Vacuum Primer VP-7401 Low Vacuum	I-106	MSPCP-1600		
36	XA-7402	DI	LCP-7402-C	Vacuum Primer VP-7402 PLC Failure	I-106	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
37	VAL-7402	DI	LCP-7402-C	Vacuum Primer VP-7402 Low Vacuum	I-106	MSPCP-1600		
38	XA-7403	DI	LCP-7403-C	Vacuum Primer VP-7403 PLC Failure	I-106	MSPCP-1600		
39	VAL-7403	DI	LCP-7403-C	Vacuum Primer VP-7403 Low Vacuum	I-106	MSPCP-1600		
40	QI-1601	DI	RVSS MSP-1	MSP-1601 On-Off	I-104	MSPCP-1600		
41	QI-1602	DI	RVSS MSP-2	MSP-1602 On-Off	I-104	MSPCP-1600		
42	QI-1603	DI	RVSS MSP-3	MSP-1603 On-Off	I-104	MSPCP-1600		
43	QI-1604	DI	RVSS MSP-4	MSP-1604 On-Off	I-105	MSPCP-1600		
44	QI-1605	DI	RVSS MSP-5	MSP-1605 On-Off	I-105	MSPCP-1600		
45	QI-1606	DI	RVSS MSP-6	MSP-1606 On-Off	I-105	MSPCP-1600		
46	QS-1601A	DI	HOA Sw MSP-1	MSP-1601 Not in Auto	I-104	MSPCP-1600		
47	QS-1602A	DI	HOA Sw MSP-2	MSP-1602 Not in Auto	I-104	MSPCP-1600		
48	QS-1603A	DI	HOA Sw MSP-3	MSP-1603 Not in Auto	I-104	MSPCP-1600		
49	QS-1604A	DI	HOA Sw MSP-4	MSP-1604 Not in Auto	I-105	MSPCP-1600		
50	QS-1605A	DI	HOA Sw MSP-5	MSP-1605 Not in Auto	I-105	MSPCP-1600		
51	QS-1606A	DI	HOA Sw MSP-6	MSP-1606 Not in Auto	I-105	MSPCP-1600		
52	UA-1601A	DI	RVSS MSP-1	MSP-1601 RVSS Fail/Overload	I-104	MSPCP-1600		
53	UA-1602A	DI	RVSS MSP-2	MSP-1602 RVSS Fail/Overload	I-104	MSPCP-1600		
54	UA-1603A	DI	RVSS MSP-3	MSP-1603 RVSS Fail/Overload	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
55	UA-1604A	DI	RVSS MSP-4	MSP-1604 RVSS Fail/Overload	I-105	MSPCP-1600		
56	UA-1605A	DI	RVSS MSP-5	MSP-1605 RVSS Fail/Overload	I-105	MSPCP-1600		
57	UA-1606A	DI	RVSS MSP-6	MSP-1606 RVSS Fail/Overload	I-105	MSPCP-1600		
58	IAH-1601	DI	BPS MSP-1	MSP-1601 Bypass Starter Overload	I-104	MSPCP-1600		
59	IAH-1602	DI	BPS MSP-2	MSP-1602 Bypass Starter Overload	I-104	MSPCP-1600		
60	IAH-1603	DI	BPS MSP-3	MSP-1603 Bypass Starter Overload	I-104	MSPCP-1600		
61	IAH-1604	DI	BPS MSP-4	MSP-1604 Bypass Starter Overload	I-105	MSPCP-1601		
62	IAH-1605	DI	BPS MSP-5	MSP-1605 Bypass Starter Overload	I-105	MSPCP-1602		
63	IAH-1606	DI	BPS MSP-6	MSP-1606 Bypass Starter Overload	I-105	MSPCP-1603		
64	ZIO-1601	DI	ZSO-1601	MSP-1601 Check Valve Open	I-104	MSPCP-1600		
65	ZIO-1602	DI	ZSO-1602	MSP-1602 Check Valve Open	I-104	MSPCP-1600		
66	ZIO-1603	DI	ZSO-1603	MSP-1603 Check Valve Open	I-104	MSPCP-1600		
67	ZIO-1604	DI	ZSO-1604	MSP-1604 Check Valve Open	I-105	MSPCP-1600		
68	ZIO-1605	DI	ZSO-1605	MSP-1605 Check Valve Open	I-105	MSPCP-1600		
69	ZIO-1606	DI	ZSO-1606	MSP-1606 Check Valve Open	I-105	MSPCP-1600		
70	ZIC-1601	DI	ZSC-1601	MSP-1601 Check Valve Close	I-104	MSPCP-1600		
71	ZIC-1602	DI	ZSC-1602	MSP-1602 Check Valve Close	I-104	MSPCP-1600		
72	ZIC-1603	DI	ZSC-1603	MSP-1603 Check Valve Close	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
73	ZIC-1604	DI	ZSC-1604	MSP-1604 Check Valve Close	I-105	MSPCP-1600		
74	ZIC-1605	DI	ZSC-1605	MSP-1605 Check Valve Close	I-105	MSPCP-1600		
75	ZIC-1606	DI	ZSC-1606	MSP-1606 Check Valve Close	I-105	MSPCP-1600		
76	XA-1600U	DI	UPS-1600	MSPCP UPS Fault	I-001	MSPCP-1600		
77	XA-1600R	DI	RPS-1600	MSPCP 24VDC RPS Fault	I-001	MSPCP-1600		
78	QS-1601	DO	MultiSmart	MSP-1601 Start-Stop Control	I-104	MSPCP-1600		
79	QS-1602	DO	MultiSmart	MSP-1602 Start-Stop Control	I-104	MSPCP-1600		
80	QS-1603	DO	MultiSmart	MSP-1603 Start-Stop Control	I-104	MSPCP-1600		
81	QS-1604	DO	MultiSmart	MSP-1604 Start-Stop Control	I-105	MSPCP-1600		
82	QS-1605	DO	MultiSmart	MSP-1605 Start-Stop Control	I-105	MSPCP-1600		
83	QS-1606	DO	MultiSmart	MSP-1606 Start-Stop Control	I-105	MSPCP-1600		
84	UA-1601B	LAN	MultiSmart	MSP-1601 Fault	I-104	MSPCP-1600		
85	UA-1602B	LAN	MultiSmart	MSP-1602 Fault	I-104	MSPCP-1600		
86	UA-1603B	LAN	MultiSmart	MSP-1603 Fault	I-104	MSPCP-1600		
87	UA-1604B	LAN	MultiSmart	MSP-1604 Fault	I-105	MSPCP-1600		
88	UA-1605B	LAN	MultiSmart	MSP-1605 Fault	I-105	MSPCP-1600		
89	UA-1606B	LAN	MultiSmart	MSP-1606 Fault	I-105	MSPCP-1600		
90	UAA-1601	LAN	MultiSmart	MSP-1601 Not in Service	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
91	UAA-1602	LAN	MultiSmart	MSP-1602 Not in Service	I-104	MSPCP-1600		
92	UAA-1603	LAN	MultiSmart	MSP-1603 Not in Service	I-104	MSPCP-1600		
93	UAA-1604	LAN	MultiSmart	MSP-1604 Not in Service	I-105	MSPCP-1600		
94	UAA-1605	LAN	MultiSmart	MSP-1605 Not in Service	I-105	MSPCP-1600		
95	UAA-1606	LAN	MultiSmart	MSP-1606 Not in Service	I-105	MSPCP-1600		
96	UA-1601C	LAN	MultiSmart	MSP-1601 Alarm	I-104	RVSS/BPS		
97	UA-1602C	LAN	MultiSmart	MSP-1602 Alarm	I-104	RVSS/BPS		
98	UA-1603C	LAN	MultiSmart	MSP-1603 Alarm	I-104	RVSS/BPS		
99	UA-1604C	LAN	MultiSmart	MSP-1604 Alarm	I-105	RVSS/BPS		
100	UA-1605C	LAN	MultiSmart	MSP-1605 Alarm	I-105	RVSS/BPS		
101	UA-1606C	LAN	MultiSmart	MSP-1606 Alarm	I-105	RVSS/BPS		
102	BU-1601	LAN	MAS-801	MSP-1601 Permissive	I-104	RVSS/BPS		
103	BU-1602	LAN	MAS-801	MSP-1602 Permissive	I-104	RVSS/BPS		
104	BU-1603	LAN	MAS-801	MSP-1603 Permissive	I-104	RVSS/BPS		
105	BU-1604	LAN	MAS-801	MSP-1604 Permissive	I-105	RVSS/BPS		
106	BU-1605	LAN	MAS-801	MSP-1605 Permissive	I-105	RVSS/BPS		
107	BU-1606	LAN	MAS-801	MSP-1606 Permissive	I-105	RVSS/BPS		
108	QC-7401A	DO	MAS-801	Vacuum Primer 7401A Start-Stop Control	I-106	LCP-7401C		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
109	QC-7402A	DO	MAS-801	Vacuum Primer 7402A Start-Stop Control	I-106	LCP-7402C		
110	QC-7403A	DO	MAS-801	Vacuum Primer 7403A Start-Stop Control	I-106	LCP-7403C		
111	QC-7401B	DO	MAS-801	Vacuum Primer 7401B Start-Stop Control	I-106	LCP-7401C		
112	QC-7402B	DO	MAS-801	Vacuum Primer 7402B Start-Stop Control	I-106	LCP-7402C		
113	QC-7403B	DO	MAS-801	Vacuum Primer 7403B Start-Stop Control	I-106	LCP-7403C		
114	TAH-1601D	LAN	MAS-801	MSP-1601 Motor Main Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
115	XA-1601A	LAN	MAS-801	MSP-1601 Motor Stator Housing Leak	I-104	MSPCP-1600		
116	TAH-1601E	LAN	MAS-801	MSP-1601 Motor Support Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
117	TAH-1601A	LAN	MAS-801	MSP-1601 Motor Winding Temperature Phase A	I-104	MSPCP-1600	0-200 ºF	
118	TAH-1601B	LAN	MAS-801	MSP-1601 Motor Winding Temperature Phase B	I-104	MSPCP-1600	0-200 ºF	
119	TAH-1601C	LAN	MAS-801	MSP-1601 Motor Winding Temperature Phase C	I-104	MSPCP-1600	0-200 ºF	
120	KI-1601S	LAN	MAS-801	MSP-1601 Number of Starts	I-104	MSPCP-1600		
121	KI-1601R	LAN	MAS-801	MSP-1601 Total Run Time	I-104	MSPCP-1600	Σ hours	
122	VAH-1601X	LAN	MAS-801	MSP-1601 Vibration X-Axis	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
123	VAH-1601Y	LAN	MAS-801	MSP-1601 Vibration Y-Axis	I-104	MSPCP-1600		
124	VAH-1601Z	LAN	MAS-801	MSP-1601 Vibration Z-Axis	I-104	MSPCP-1600		
125	XA-1601B	LAN	MAS-801	MSP-1601 Water in Oil	I-104	MSPCP-1600		
126	TAH-1602D	LAN	MAS-801	MSP-1602 Motor Main Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
127	XA-1602A	LAN	MAS-801	MSP-1602 Motor Stator Housing Leak	I-104	MSPCP-1600		
128	TAH-1602E	LAN	MAS-801	MSP-1602 Motor Support Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
129	TAH-1602A	LAN	MAS-801	MSP-1602 Motor Winding Temperature Phase A	I-104	MSPCP-1600	0-200 ºF	
130	TAH-1602B	LAN	MAS-801	MSP-1602 Motor Winding Temperature Phase B	I-104	MSPCP-1600	0-200 ºF	
131	TAH-1602C	LAN	MAS-801	MSP-1602 Motor Winding Temperature Phase C	I-104	MSPCP-1600	0-200 ºF	
132	KI-1602S	LAN	MAS-801	MSP-1602 Number of Starts	I-104	MSPCP-1600		
133	KI-1602R	LAN	MAS-801	MSP-1602 Total Run Time	I-104	MSPCP-1600	Σ hours	
134	VAH-1602X	LAN	MAS-801	MSP-1602 Vibration X-Axis	I-104	MSPCP-1600		
135	VAH-1602Y	LAN	MAS-801	MSP-1602 Vibration Y-Axis	I-104	MSPCP-1600		
136	VAH-1602Z	LAN	MAS-801	MSP-1602 Vibration Z-Axis	I-104	MSPCP-1600		
137	XA-1602B	LAN	MAS-801	MSP-1602 Water in Oil	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
138	TAH-1603D	LAN	MAS-801	MSP-1603 Motor Main Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
139	XA-1603A	LAN	MAS-801	MSP-1603 Motor Stator Housing Leak	I-104	MSPCP-1600		
140	TAH-1603E	LAN	MAS-801	MSP-1603 Motor Support Bearing Temperature	I-104	MSPCP-1600	0-200 ºF	
141	TAH-1603A	LAN	MAS-801	MSP-1603 Motor Winding Temperature Phase A	I-104	MSPCP-1600	0-200 ºF	
142	TAH-1603B	LAN	MAS-801	MSP-1603 Motor Winding Temperature Phase B	I-104	MSPCP-1600	0-200 ºF	
143	TAH-1603C	LAN	MAS-801	MSP-1603 Motor Winding Temperature Phase C	I-104	MSPCP-1600	0-200 ºF	
144	KI-1603S	LAN	MAS-801	MSP-1603 Number of Starts	I-104	MSPCP-1600		
145	KI-1603R	LAN	MAS-801	MSP-1603 Total Run Time	I-104	MSPCP-1600	Σ hours	
146	VAH-1603X	LAN	MAS-801	MSP-1603 Vibration X-Axis	I-104	MSPCP-1600		
147	VAH-1603Y	LAN	MAS-801	MSP-1603 Vibration Y-Axis	I-104	MSPCP-1600		
148	VAH-1603Z	LAN	MAS-801	MSP-1603 Vibration Z-Axis	I-104	MSPCP-1600		
149	XA-1603B	LAN	MAS-801	MSP-1603 Water in Oil	I-104	MSPCP-1600		
150	TAH-1604D	LAN	MAS-801	MSP-1604 Motor Main Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	
151	XA-1604A	LAN	MAS-801	MSP-1604 Motor Stator Housing Leak	I-105	MSPCP-1600		
152	TAH-1604E	LAN	MAS-801	MSP-1604 Motor Support Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
153	TAH-1604A	LAN	MAS-801	MSP-1604 Motor Winding Temperature Phase A	I-105	MSPCP-1600	0-200 ºF	
154	TAH-1604B	LAN	MAS-801	MSP-1604 Motor Winding Temperature Phase B	I-105	MSPCP-1600	0-200 ºF	
155	TAH-1604C	LAN	MAS-801	MSP-1604 Motor Winding Temperature Phase C	I-105	MSPCP-1600	0-200 ºF	
156	KI-1604S	LAN	MAS-801	MSP-1604 Number of Starts	I-105	MSPCP-1600		
157	KI-1604R	LAN	MAS-801	MSP-1604 Total Run Time	I-105	MSPCP-1600	Σ hours	
158	VAH-1604X	LAN	MAS-801	MSP-1604 Vibration X-Axis	I-105	MSPCP-1600		
159	VAH-1604Y	LAN	MAS-801	MSP-1604 Vibration Y-Axis	I-105	MSPCP-1600		
160	VAH-1604Z	LAN	MAS-801	MSP-1604 Vibration Z-Axis	I-105	MSPCP-1600		
161	XA-1604B	LAN	MAS-801	MSP-1604 Water in Oil	I-105	MSPCP-1600		
162	TAH-1605D	LAN	MAS-801	MSP-1605 Motor Main Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	
163	XA-1605A	LAN	MAS-801	MSP-1605 Motor Stator Housing Leak	I-105	MSPCP-1600		
164	TAH-1605E	LAN	MAS-801	MSP-1605 Motor Support Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	
165	TAH-1605A	LAN	MAS-801	MSP-1605 Motor Winding Temperature Phase A	I-105	MSPCP-1600	0-200 ºF	
166	TAH-1605B	LAN	MAS-801	MSP-1605 Motor Winding Temperature Phase B	I-105	MSPCP-1600	0-200 ºF	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
167	TAH-1605C	LAN	MAS-801	MSP-1605 Motor Winding Temperature Phase C	I-105	MSPCP-1600	0-200 ºF	
168	KI-1605S	LAN	MAS-801	MSP-1605 Number of Starts	I-105	MSPCP-1600		
169	KI-1605R	LAN	MAS-801	MSP-1605 Total Run Time	I-105	MSPCP-1600	Σ hours	
170	VAH-1605X	LAN	MAS-801	MSP-1605 Vibration X-Axis	I-105	MSPCP-1600		
171	VAH-1605Y	LAN	MAS-801	MSP-1605 Vibration Y-Axis	I-105	MSPCP-1600		
172	VAH-1605Z	LAN	MAS-801	MSP-1605 Vibration Z-Axis	I-105	MSPCP-1600		
173	XA-1605B	LAN	MAS-801	MSP-1605 Water in Oil	I-105	MSPCP-1600		
174	TAH-1606D	LAN	MAS-801	MSP-1606 Motor Main Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	
175	XA-1606A	LAN	MAS-801	MSP-1606 Motor Stator Housing Leak	I-105	MSPCP-1600		
176	TAH-1606E	LAN	MAS-801	MSP-1606 Motor Support Bearing Temperature	I-105	MSPCP-1600	0-200 ºF	
177	TAH-1606A	LAN	MAS-801	MSP-1606 Motor Winding Temperature Phase A	I-105	MSPCP-1600	0-200 ºF	
178	TAH-1606B	LAN	MAS-801	MSP-1606 Motor Winding Temperature Phase B	I-105	MSPCP-1600	0-200 ºF	
179	TAH-1606C	LAN	MAS-801	MSP-1606 Motor Winding Temperature Phase C	I-105	MSPCP-1600	0-200 ºF	
180	KI-1606S	LAN	MAS-801	MSP-1606 Number of Starts	I-105	MSPCP-1600		
181	KI-1606R	LAN	MAS-801	MSP-1606 Total Run Time	I-105	MSPCP-1600	Σ hours	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
182	VAH-1606X	LAN	MAS-801	MSP-1606 Vibration X-Axis	I-105	MSPCP-1600		
183	VAH-1606Y	LAN	MAS-801	MSP-1606 Vibration Y-Axis	I-105	MSPCP-1600		
184	VAH-1606Z	LAN	MAS-801	MSP-1606 Vibration Z-Axis	I-105	MSPCP-1600		
185	XA-1606B	LAN	MAS-801	MSP-1606 Water in Oil	I-105	MSPCP-1600		
186	AI-1601	LAN	MultiSmart	MSP-1601 Available	I-104	MSPCP-1600		
187	AI-1602	LAN	MultiSmart	MSP-1602 Available	I-104	MSPCP-1600		
188	AI-1603	LAN	MultiSmart	MSP-1603 Available	I-104	MSPCP-1600		
189	AI-1604	LAN	MultiSmart	MSP-1604 Available	I-105	MSPCP-1601		
190	AI-1605	LAN	MultiSmart	MSP-1605 Available	I-105	MSPCP-1602		
191	AI-1606	LAN	MultiSmart	MSP-1606 Available	I-105	MSPCP-1603		
192	IA-1601	LAN	Power Analyzer	MSP-1601 Motor Current Imbalance	I-104	MSPCP-1600		
193	II-1601A	LAN	Power Analyzer	MSP-1601 Motor Current Phase A	I-104	MSPCP-1600	0-150 A	
194	II-1601B	LAN	Power Analyzer	MSP-1601 Motor Current Phase B	I-104	MSPCP-1600	0-150 A	
195	II-1601C	LAN	Power Analyzer	MSP-1601 Motor Current Phase C	I-104	MSPCP-1600	0-150 A	
196	JKI-1601	LAN	Power Analyzer	MSP-1601 Motor Energy	I-104	MSPCP-1600	Σ kWh	
197	JI-1601	LAN	Power Analyzer	MSP-1601 Motor Power	I-104	MSPCP-1600	0-100 kW	
198	JU-1601	LAN	Power Analyzer	MSP-1601 Motor Power Factor	I-104	MSPCP-1600	0-100%	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
199	EA-1601	LAN	Power Analyzer	MSP-1601 Motor Voltage Imbalance	I-104	MSPCP-1600		
200	EI-1601A	LAN	Power Analyzer	MSP-1601 Motor Voltage Phase A	I-104	MSPCP-1600	0-600 V	
201	EI-1601B	LAN	Power Analyzer	MSP-1601 Motor Voltage Phase B	I-104	MSPCP-1600	0-600 V	
202	EI-1601C	LAN	Power Analyzer	MSP-1601 Motor Voltage Phase C	I-104	MSPCP-1600	0-600 V	
203	IA-1602	LAN	Power Analyzer	MSP-1602 Motor Current Imbalance	I-104	MSPCP-1600		
204	II-1602A	LAN	Power Analyzer	MSP-1602 Motor Current Phase A	I-104	MSPCP-1600	0-150 A	
205	II-1602B	LAN	Power Analyzer	MSP-1602 Motor Current Phase B	I-104	MSPCP-1600	0-150 A	
206	II-1602C	LAN	Power Analyzer	MSP-1602 Motor Current Phase C	I-104	MSPCP-1600	0-150 A	
207	JKI-1602	LAN	Power Analyzer	MSP-1602 Motor Energy	I-104	MSPCP-1600	Σ kWh	
208	JI-1602	LAN	Power Analyzer	MSP-1602 Motor Power	I-104	MSPCP-1600	0-100 kW	
209	JU-1602	LAN	Power Analyzer	MSP-1602 Motor Power Factor	I-104	MSPCP-1600	0-100%	
210	EA-1602	LAN	Power Analyzer	MSP-1602 Motor Voltage Imbalance	I-104	MSPCP-1600		
211	EI-1602A	LAN	Power Analyzer	MSP-1602 Motor Voltage Phase A	I-104	MSPCP-1600	0-600 V	
212	EI-1602B	LAN	Power Analyzer	MSP-1602 Motor Voltage Phase B	I-104	MSPCP-1600	0-600 V	
213	EI-1602C	LAN	Power Analyzer	MSP-1602 Motor Voltage Phase C	I-104	MSPCP-1600	0-600 V	
214	IA-1603	LAN	Power Analyzer	MSP-1603 Motor Current Imbalance	I-104	MSPCP-1600		
215	II-1603A	LAN	Power Analyzer	MSP-1603 Motor Current Phase A	I-104	MSPCP-1600	0-150 A	
216	II-1603B	LAN	Power Analyzer	MSP-1603 Motor Current Phase B	I-104	MSPCP-1600	0-150 A	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
217	II-1603C	LAN	Power Analyzer	MSP-1603 Motor Current Phase C	I-104	MSPCP-1600	0-150 A	
218	JKI-1603	LAN	Power Analyzer	MSP-1603 Motor Energy	I-104	MSPCP-1600	Σ kWh	
219	JI-1603	LAN	Power Analyzer	MSP-1603 Motor Power	I-104	MSPCP-1600	0-100 kW	
220	JU-1603	LAN	Power Analyzer	MSP-1603 Motor Power Factor	I-104	MSPCP-1600	0-100%	
221	EA-1603	LAN	Power Analyzer	MSP-1603 Motor Voltage Imbalance	I-104	MSPCP-1600		
222	EI-1603A	LAN	Power Analyzer	MSP-1603 Motor Voltage Phase A	I-104	MSPCP-1600	0-600 V	
223	EI-1603B	LAN	Power Analyzer	MSP-1603 Motor Voltage Phase B	I-104	MSPCP-1600	0-600 V	
224	EI-1603C	LAN	Power Analyzer	MSP-1603 Motor Voltage Phase C	I-104	MSPCP-1600	0-600 V	
225	IA-1604	LAN	Power Analyzer	MSP-1604 Motor Current Imbalance	I-105	MSPCP-1600		
226	II-1604A	LAN	Power Analyzer	MSP-1604 Motor Current Phase A	I-105	MSPCP-1600	0-150 A	
227	II-1604B	LAN	Power Analyzer	MSP-1604 Motor Current Phase B	I-105	MSPCP-1600	0-150 A	
228	II-1604C	LAN	Power Analyzer	MSP-1604 Motor Current Phase C	I-105	MSPCP-1600	0-150 A	
229	JKI-1604	LAN	Power Analyzer	MSP-1604 Motor Energy	I-105	MSPCP-1600	Σ kWh	
230	JI-1604	LAN	Power Analyzer	MSP-1604 Motor Power	I-105	MSPCP-1600	0-100 kW	
231	JU-1604	LAN	Power Analyzer	MSP-1604 Motor Power Factor	I-105	MSPCP-1600	0-100%	
232	EA-1604	LAN	Power Analyzer	MSP-1604 Motor Voltage Imbalance	I-105	MSPCP-1600		
233	EI-1604A	LAN	Power Analyzer	MSP-1604 Motor Voltage Phase A	I-105	MSPCP-1600	0-600 V	
234	EI-1604B	LAN	Power Analyzer	MSP-1604 Motor Voltage Phase B	I-105	MSPCP-1600	0-600 V	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
235	EI-1604C	LAN	Power Analyzer	MSP-1604 Motor Voltage Phase C	I-105	MSPCP-1600	0-600 V	
236	IA-1605	LAN	Power Analyzer	MSP-1605 Motor Current Imbalance	I-105	MSPCP-1600		
237	II-1605A	LAN	Power Analyzer	MSP-1605 Motor Current Phase A	I-105	MSPCP-1600	0-150 A	
238	II-1605B	LAN	Power Analyzer	MSP-1605 Motor Current Phase B	I-105	MSPCP-1600	0-150 A	
239	II-1605C	LAN	Power Analyzer	MSP-1605 Motor Current Phase C	I-105	MSPCP-1600	0-150 A	
240	JKI-1605	LAN	Power Analyzer	MSP-1605 Motor Energy	I-105	MSPCP-1600	Σ kWh	
241	JI-1605	LAN	Power Analyzer	MSP-1605 Motor Power	I-105	MSPCP-1600	0-100 kW	
242	JU-1605	LAN	Power Analyzer	MSP-1605 Motor Power Factor	I-105	MSPCP-1600	0-100%	
243	EA-1605	LAN	Power Analyzer	MSP-1605 Motor Voltage Imbalance	I-105	MSPCP-1600		
244	EI-1605A	LAN	Power Analyzer	MSP-1605 Motor Voltage Phase A	I-105	MSPCP-1600	0-600 V	
245	EI-1605B	LAN	Power Analyzer	MSP-1605 Motor Voltage Phase B	I-105	MSPCP-1600	0-600 V	
246	EI-1605C	LAN	Power Analyzer	MSP-1605 Motor Voltage Phase C	I-105	MSPCP-1600	0-600 V	
247	IA-1606	LAN	Power Analyzer	MSP-1606 Motor Current Imbalance	I-105	MSPCP-1600		
248	II-1606A	LAN	Power Analyzer	MSP-1606 Motor Current Phase A	I-105	MSPCP-1600	0-150 A	
249	II-1606B	LAN	Power Analyzer	MSP-1606 Motor Current Phase B	I-105	MSPCP-1600	0-150 A	
250	II-1606C	LAN	Power Analyzer	MSP-1606 Motor Current Phase C	I-105	MSPCP-1600	0-150 A	
251	JKI-1606	LAN	Power Analyzer	MSP-1606 Motor Energy	I-105	MSPCP-1600	Σ kWh	
252	JI-1606	LAN	Power Analyzer	MSP-1606 Motor Power	I-105	MSPCP-1600	0-100 kW	

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
253	JU-1606	LAN	Power Analyzer	MSP-1606 Motor Power Factor	I-105	MSPCP-1600	0-100%	
254	EA-1606	LAN	Power Analyzer	MSP-1606 Motor Voltage Imbalance	I-105	MSPCP-1600		
255	EI-1606A	LAN	Power Analyzer	MSP-1606 Motor Voltage Phase A	I-105	MSPCP-1600	0-600 V	
256	EI-1606B	LAN	Power Analyzer	MSP-1606 Motor Voltage Phase B	I-105	MSPCP-1600	0-600 V	
257	EI-1606C	LAN	Power Analyzer	MSP-1606 Motor Voltage Phase C	I-105	MSPCP-1600	0-600 V	
258	LAH-7401	LAN	LCP-7401-C	VP-7401 Receiver Tank High Water Level	I-106	MSPCP-1600		
259	KI-7401AR	LAN	LCP-7401-C	VP-7401A Vacuum Pump Run Time	I-106	MSPCP-1600		
260	QI-7401AA	LAN	LCP-7401-C	VP-7401A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
261	IAH-7401A	LAN	LCP-7401-C	VP-7401A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
262	PAL-7401AA	LAN	LCP-7401-C	VP-7401A Low Oil Pressure	I-106	MSPCP-1600		
263	QI-7401AB	LAN	LCP-7401-C	VP-7401A Not in Auto	I-106	MSPCP-1600		
264	KI-7401BR	LAN	LCP-7401-C	VP-7401B Vacuum Pump Run Time	I-106	MSPCP-1600		
265	QI-7401BA	LAN	LCP-7401-C	VP-7401B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
266	IAH-7401B	LAN	LCP-7401-C	VP-7401B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
267	PAL-7401BA	LAN	LCP-7401-C	VP-7401B Low Oil Pressure	I-106	MSPCP-1600		
268	QI-7401BB	LAN	LCP-7401-C	VP-7401B Not in Auto	I-106	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
269	LAH-7402	LAN	LCP-7402-C	VP-7402 Receiver Tank High Water Level	I-106	MSPCP-1600		
270	KI-7402AR	LAN	LCP-7402-C	VP-7402A Vacuum Pump Run Time	I-106	MSPCP-1600		
271	QI-7402AB	LAN	LCP-7402-C	VP-7402A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
272	IAH-7402A	LAN	LCP-7402-C	VP-7402A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
273	PAL-7402A	LAN	LCP-7402-C	VP-7402A Low Oil Pressure	I-106	MSPCP-1600		
274	QI-7402AB	LAN	LCP-7402-C	VP-7402A Not in Auto	I-106	MSPCP-1600		
275	KI-7402BR	LAN	LCP-7402-C	VP-7402B Vacuum Pump Run Time	I-106	MSPCP-1600		
276	QI-7402BB	LAN	LCP-7402-C	VP-7402B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
277	IAH-7402B	LAN	LCP-7402-C	VP-7402B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
278	PAL-7402B	LAN	LCP-7402-C	VP-7402B Low Oil Pressure	I-106	MSPCP-1600		
279	QI-7402BB	LAN	LCP-7402-C	VP-7402B Not in Auto	I-106	MSPCP-1600		
280	LAH-7403	LAN	LCP-7403-C	VP-7403 Receiver Tank High Water Level	I-106	MSPCP-1600		
281	KI-7403AR	LAN	LCP-7403-C	VP-7403A Vacuum Pump Run Time	I-106	MSPCP-1600		
282	QI-7403AB	LAN	LCP-7403-C	VP-7403A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
283	IAH-7403A	LAN	LCP-7403-C	VP-7403A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
284	PAL-7403A	LAN	LCP-7403-C	VP-7403A Low Oil Pressure	I-106	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
285	QI-7403AB	LAN	LCP-7403-C	VP-7403A Not in Auto	I-106	MSPCP-1600		
286	KI-7403BR	LAN	LCP-7403-C	VP-7403B Vacuum Pump Run Time	I-106	MSPCP-1600		
287	QI-7403BB	LAN	LCP-7403-C	VP-7403B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
288	IAH-7403B	LAN	LCP-7403-C	VP-7403B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
289	PAL-7403B	LAN	LCP-7403-C	VP-7403B Low Oil Pressure	I-106	MSPCP-1600		
290	QI-7403BB	LAN	LCP-7403-C	VP-7403B Not in Auto	I-106	MSPCP-1600		
291	ECA-1601	LAN	RVSS/BPS	MSP-1601 Control Voltage Fail	I-104	MSPCP-1600		
292	ECA-1602	LAN	RVSS/BPS	MSP-1602 Control Voltage Fail	I-104	MSPCP-1600		
293	ECA-1603	LAN	RVSS/BPS	MSP-1603 Control Voltage Fail	I-104	MSPCP-1600		
294	ECA-1604	LAN	RVSS/BPS	MSP-1604 Control Voltage Fail	I-105	MSPCP-1600		
295	ECA-1605	LAN	RVSS/BPS	MSP-1605 Control Voltage Fail	I-105	MSPCP-1600		
296	ECA-1606	LAN	RVSS/BPS	MSP-1606 Control Voltage Fail	I-105	MSPCP-1600		
297	ZAC-1601	LAN	1601-20-02	MSP-1601 Check Valve Not Fully Closed	I-104	MSPCP-1600		
298	ZAC-1602	LAN	1602-20-02	MSP-1602 Check Valve Not Fully Open	I-104	MSPCP-1600		
299	ZAC-1603	LAN	1603-20-02	MSP-1603 Check Valve Not Fully Closed	I-104	MSPCP-1600		
300	ZAO-1601	LAN	1601-20-02	MSP-1601 Check Valve Not Fully Open	I-104	MSPCP-1600		
301	ZAO-1602	LAN	1602-20-02	MSP-1602 Check Valve Not Fully Open	I-104	MSPCP-1600		

Table 1 - Input/Output List - MSPCP-1600

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
302	ZAO-1603	LAN	1603-20-02	MSP-1603 Check Valve Not Fully Closed	I-104	MSPCP-1600		
303	ZAC-1604	LAN	1604-20-02	MSP-1604 Check Valve Not Fully Closed	I-105	MSPCP-1600		
304	ZAC-1605	LAN	1605-20-02	MSP-1605 Check Valve Not Fully Closed	I-105	MSPCP-1600		
305	ZAO-1604	LAN	1604-20-02	MSP-1604 Check Valve Not Fully Open	I-105	MSPCP-1600		
306	ZAO-1605	LAN	1605-20-02	MSP-1605 Check Valve Not Fully Open	I-105	MSPCP-1600		
307	ZAO-1606	LAN	1606-20-02	MSP-1606 Check Valve Not Fully Open	I-105	MSPCP-1600		
308	ZAC-1606	LAN	1606-20-02	MSP-1606 Check Valve Not Fully Closed	I-105	MSPCP-1600		

PHYSICAL I/O COUNT - MSPCP-1600			
I/O Type	Used	Spare	Required
AI	14	4	18
AO	0	0	0
DI	53	13	66
DO	12	3	15

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
1	AI-121	AI	Gas Detector	Methane Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
2	AI-122	AI	Gas Detector	Methane Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
3	AI-131	AI	Gas Detector	Hydrogen Sulfide Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
4	AI-132	AI	Gas Detector	Hydrogen Sulfide Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
5	AI-141	AI	Gas Detector	Oxygen Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
6	AI-142	AI	Gas Detector	Oxygen Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
7	AI-151	AI	Gas Detector	Carbon Monoxide Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
8	AI-152	AI	Gas Detector	Carbon Monoxide Gas in Wet Well	I-103	PMCS-9110	0-100% LEL	
9	FIR-026	*	LT-026	Ralph Avenue Inlet Bypass Chamber Flow (Flow)	I-103	PMCS-9110	0-80 mgd	
10	PIR-1602	LAN	MSPCP-1600	MSP-1602 Discharge Pressure	I-104	MSPCP-1600	0-15 psi	
11	ZI-1301A	AI	LCP-1301-48-S	Ralph Avenue Inlet Gate Position Indication	I-103	PMCS-9110	0-100% Open	
12	ZI-1302A	AI	LCP-1302-48-S	Avenue M Inlet Gate Position Indication	I-103	PMCS-9110	0-100% Open	
13	FIRQ-1610H	AI	FIT-1610H	High Service Header Flow Rate & Total Flow	I-104	PMCS-9110	0-40 mgd	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
14	FIRQ-1610L	AI	FIT-1610L	Low Service Header Flow Rate & Total Flow	I-105	PMCS-9110	0-40 mgd	
15	PIR-1610H	AI	PIT-1610H	High Service Header Pressure	I-104	PMCS-9110	0-15 psi	
16	PIR-1610L	AI	PIT-1610L	High Service Header Pressure	I-105	PMCS-9110	0-15 psi	
17	FC-026	AO	PLC	Ralph Avenue Inlet Gate Position Control	I-103	PMCS-9110		
18	QI-030	DI	BSCP Relay	Backup System Active	I-103	PMCS-9110		
19	QA-030	DI	BSCP Sel Sw	Backup System Not in Auto	I-103	PMCS-9110		
20	XA-7791A	DI	LCP-7791	Sump Pump SP-1A Fault	I-108	PMCS-9110		
21	XA-7791B	DI	LCP-7791	Sump Pump SP-1B Fault	I-108	PMCS-9110		
22	LAHH-7791	DI	Float Switch	Sump Pit 1 High Level/Flooding	I-108	PMCS-9110		
23	XA-7792A	DI	LCP-7792	Sump Pump SP-2 Fault	I-108	PMCS-9110		
24	LAHH-7792	DI	Float Switch	Sump Pit 2 High Level/Flooding	I-108	PMCS-9110		
25	XA-7793	DI	LCP-7793	Sump Pump SP-3 Fault	I-108	PMCS-9110		
26	LAHH-7793	DI	Float Switch	Sump Pit 3 High Level/Flooding	I-108	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
27	XA-7794	DI	LCP-7794	Sump Pump SP-4 Fault	I-108	PMCS-9110		
28	LAHH-7794	DI	Float Switch	Sump Pit 4 High Level/Flooding	I-108	PMCS-9110		
29	XA-7795	DI	LCP-7795	Sump Pump SP-5 Fault	I-108	PMCS-9110		
30	LAHH-7795	DI	Float Switch	Sump Pit 5 High Level/Flooding	I-108	PMCS-9110		
31	XA-7796	DI	LCP-7796	Sump Pump SP-6 Fault	I-108	PMCS-9110		
32	LAHH-7796	DI	Float Switch	Sump Pit 6 High Level/Flooding	I-108	PMCS-9110		
33	XA-7797	DI	LCP-7797	Sump Pump SP-7 Fault	I-108	PMCS-9110		
34	LAHH-7797	DI	Float Switch	Sump Pit 7 High Level/Flooding	I-108	PMCS-9110		
35	QI-1601P	LAN	LS-1601P	MSP-1601 Proof of Prime	I-104	MSPCP-1600		
36	XA-7901	DI	LCP-7901	Service Air Compressor Malfunction	I-108	PMCS-9110		
37	QI-1602P	LAN	LS-1602P	MSP-1602 Proof of Prime	I-104	MSPCP-1600		
38	PAL-7902	DI	PSL-7902	Service Air Low Pressure	I-108	PMCS-9110		
39	QI-1603P	LAN	LS-1603P	MSP-1603 Proof of Prime	I-104	MSPCP-1600		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
40	PAL-7601	DI	PSL-7601	Service Water Low Pressure	I-107	PMCS-9110		
41	XA-8101	DI	FACP-8100	Trouble Alarm	I-107	PMCS-9110		
42	UA-8101	DI	FACP-8100	Fire Alarm	I-107	PMCS-9110		
43	XA-8101A	DI	FACP-8100	Supervisory Alarm	I-107	PMCS-9110		
44	UA-7301	DI	ATC-1	HVAC Alarm - Screening Chamber	I-107	PMCS-9110		
45	UA-7302	DI	ATC-2	HVAC Alarm - Wet Well	I-107	PMCS-9110		
46	UA-7303	DI	ATC-3	HVAC Alarm - Dry Well	I-107	PMCS-9110		
47	UA-7304	DI	AC-1	HVAC Alarm - Electrical Room	I-107	PMCS-9110		
48	ZIO-1301A	DI	LCP-1301-48-S	Ralph Avenue Inlet Gate Open Indication	I-103	PMCS-9110		
49	ZIC-1301B	DI	LCP-1301-48-S	Ralph Avenue Inlet Gate Closed Indication	I-103	PMCS-9110		
50	XA-1301A	DI	LCP-1301-48-S	Ralph Avenue Inlet Gate Jam Alarm	I-103	PMCS-9110		
51	ZIO-1302A	DI	LCP-1302-48-S	Ralph Avenue Inlet Gate Open Indication	I-103	PMCS-9110		
52	ZIC-1302B	DI	LCP-1302-48-S	Ralph Avenue Inlet Gate Closed Indication	I-103	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
53	XA-1302A	DI	LCP-1302-48-S	Ralph Avenue Inlet Gate Jam Alarm	I-103	PMCS-9110		
54	XA-9110R	DI	RPS-9110	PMCS 24VDC RPS Fault	I-101	PMCS-9110		
55	XA-9110U	DI	UPS-9110	PMCS UPS Fault	I-101	PMCS-9110		
56	AAH-120	DO	LAP-120	35% LEL Hazardous Gas Alarm	I-103	PMCS-9110		
57	AAHH-120	DO	LAP-120	60% LEL Hazardous Gas Alarm	I-103	PMCS-9110		
58	AAH-140	DO	LAP-140	35% LEL Hazardous Gas Alarm	I-103	PMCS-9110		
59	AAHH-140	DO	LAP-140	60% LEL Hazardous Gas Alarm	I-103	PMCS-9110		
60	IAH-1601	LAN	MSPCP-1600	MSP-1601 Bypass Starter Overload	I-104	PMCS-9110		
61	IAH-1602	LAN	MSPCP-1600	MSP-1602 Bypass Starter Overload	I-104	PMCS-9110		
62	IAH-1603	LAN	MSPCP-1600	MSP-1603 Bypass Starter Overload	I-104	MSPCP-1600		
63	IAH-1604	LAN	MSPCP-1600	MSP-1604 Bypass Starter Overload	I-105	PMCS-9110		
64	HC-1301A	DO	PLC	Ralph Avenue Inlet Gate Open Control	I-103	PMCS-9110		
65	HC-1301B	DO	PLC	Ralph Avenue Inlet Gate Stop Control	I-103	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
66	HC-1301C	DO	PLC	Ralph Avenue Inlet Gate Close Control	I-103	PMCS-9110		
67	IAH-1605	DI	BPS MSP-4	MSP-1605 Bypass Starter Overload	I-105	MSPCP-1601		
68	IAH-1606	LAN	MSPCP-1600	MSP-1606 Bypass Starter Overload	I-105	PMCS-9110		
69	HC-1302A	DO	PLC	Avenue M Inlet Gate Open Control	I-103	PMCS-9110		
70	HC-1302B	DO	PLC	Avenue M Inlet Gate Stop Control	I-103	PMCS-9110		
71	HC-1302C	DO	PLC	Avenue M Inlet Gate Close Control	I-103	PMCS-9110		
72	QI-030	LAN	MSPCP-1600	Backup System Active	I-103	PMCS-9110		
73	AI-1601	LAN	MSPCP-1600	MSP-1601 Available	I-104	PMCS-9110		
74	ZIC-1601	LAN	MSPCP-1600	MSP-1601 Check Valve Closed	I-104	PMCS-9110		
75	ZAC-1601	LAN	MSPCP-1600	MSP-1601 Check Valve Not Fully Closed	I-104	PMCS-9110		
76	ZAO-1601	LAN	MSPCP-1600	MSP-1601 Check Valve Not Fully Open	I-104	PMCS-9110		
77	ZIO-1601	LAN	MSPCP-1600	MSP-1601 Check Valve Open	I-104	PMCS-9110		
78	ECI-1601	LAN	MSPCP-1600	MSP-1601 Control Voltage	I-104	PMCS-9110	0-150 V	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
79	ECA-1601	LAN	MSPCP-1600	MSP-1601 Control Voltage Fail	I-104	PMCS-9110		
80	PIR-1601	LAN	MSPCP-1600	MSP-1601 Discharge Pressure	I-104	PMCS-9110	0-100 psi	
81	UA-1601A	LAN	MSPCP-1600	MSP-1601 Fault	I-104	PMCS-9110		
82	IA-1601	LAN	MSPCP-1600	MSP-1601 Motor Current Imbalance	I-104	PMCS-9110		
83	II-1601A	LAN	MSPCP-1600	MSP-1601 Motor Current Phase A	I-104	PMCS-9110	0-150 A	
84	II-1601B	LAN	MSPCP-1600	MSP-1601 Motor Current Phase B	I-104	PMCS-9110	0-150 A	
85	II-1601C	LAN	MSPCP-1600	MSP-1601 Motor Current Phase C	I-104	PMCS-9110	0-150 A	
86	JKI-1601	LAN	MSPCP-1600	MSP-1601 Motor Energy	I-104	PMCS-9110	Σ kWh	
87	TAH-1601D	LAN	MSPCP-1600	MSP-1601 Motor Main Bearing Temperature	I-104	PMCS-9110	0-200 ºF	
88	JI-1601	LAN	MSPCP-1600	MSP-1601 Motor Power	I-104	PMCS-9110	0-100 kW	
89	JU-1601	LAN	MSPCP-1600	MSP-1601 Motor Power Factor	I-104	PMCS-9110	0-100%	
90	XA-1601A	LAN	MSPCP-1600	MSP-1601 Motor Stator Housing Leak	I-104	PMCS-9110		
91	TAH-1601E	LAN	MSPCP-1600	MSP-1601 Motor Support Bearing Temperature	I-104	PMCS-9110	0-200 ºF	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
92	EA-1601	LAN	MSPCP-1600	MSP-1601 Motor Voltage Imbalance	I-104	PMCS-9110		
93	EI-1601A	LAN	MSPCP-1600	MSP-1601 Motor Voltage Phase A	I-104	PMCS-9110	0-600 V	
94	EI-1601B	LAN	MSPCP-1600	MSP-1601 Motor Voltage Phase B	I-104	PMCS-9110	0-600 V	
95	EI-1601C	LAN	MSPCP-1600	MSP-1601 Motor Voltage Phase C	I-104	PMCS-9110	0-600 V	
96	TAH-1601A	LAN	MSPCP-1600	MSP-1601 Motor Winding Temperature Phase A	I-104	PMCS-9110	0-200 ºF	
97	TAH-1601B	LAN	MSPCP-1600	MSP-1601 Motor Winding Temperature Phase B	I-104	PMCS-9110	0-200 ºF	
98	TAH-1601C	LAN	MSPCP-1600	MSP-1601 Motor Winding Temperature Phase C	I-104	PMCS-9110	0-200 ºF	
99	QS-1601	LAN	MSPCP-1600	MSP-1601 Not in Auto	I-104	PMCS-9110		
100	UAA-1601	LAN	MSPCP-1600	MSP-1601 Not in Service	I-104	PMCS-9110		
101	KI-1601S	LAN	MSPCP-1600	MSP-1601 Number of Starts	I-104	PMCS-9110		
102	QI-1601	LAN	MSPCP-1600	MSP-1601 On-Off	I-104	PMCS-9110		
103	UA-1601B	LAN	MSPCP-1600	MSP-1601 RVSS Fail/Motor Overload	I-104	PMCS-9110		
104	UA-1601C	LAN	MSPCP-1600	MSP-1601 Alarm	I-104	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
105	UA-1602C	LAN	MSPCP-1600	MSP-1602 Alarm	I-104	PMCS-9110		
106	UA-1603C	LAN	MSPCP-1600	MSP-1603 Alarm	I-104	PMCS-9110		
107	UA-1604C	LAN	MSPCP-1600	MSP-1604 Alarm	I-105	PMCS-9110		
108	KI-1601R	LAN	MSPCP-1600	MSP-1601 Total Run Time	I-104	PMCS-9110	Σ hours	
109	VAH-1601X	LAN	MSPCP-1600	MSP-1601 Vibration X-Axis	I-104	PMCS-9110		
110	VAH-1601Y	LAN	MSPCP-1600	MSP-1601 Vibration Y-Axis	I-104	PMCS-9110		
111	UA-1605C	LAN	MSPCP-1600	MSP-1605 Alarm	I-105	PMCS-9110		
112	VAH-1601Z	LAN	MSPCP-1600	MSP-1601 Vibration Z-Axis	I-104	PMCS-9110		
113	XA-1601B	LAN	MSPCP-1600	MSP-1601 Water in Oil	I-104	PMCS-9110		
114	AI-1602	LAN	MSPCP-1600	MSP-1602 Available	I-104	PMCS-9110		
115	BU-1601	LAN	MSPCP-1600	MSP-1601 Permissive	I-104	RVSS/BPS		
116	BU-1602	LAN	MSPCP-1600	MSP-1602 Permissive	I-104	PMCS-9110		
117	BU-1603	LAN	MSPCP-1600	MSP-1603 Permissive	I-104	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
118	BU-1604	LAN	MSPCP-1600	MSP-1604 Permissive	I-105	PMCS-9110		
119	ZIC-1602	LAN	MSPCP-1600	MSP-1602 Check Valve Closed	I-104	PMCS-9110		
120	ZAC-1602	LAN	MSPCP-1600	MSP-1602 Check Valve Not Fully Closed	I-104	PMCS-9110		
121	ZAO-1602	LAN	MSPCP-1600	MSP-1602 Check Valve Not Fully Open	I-104	PMCS-9110		
122	BU-1605	LAN	MAS-801	MSP-1605 Permissive	I-105	RVSS/BPS		
123	BU-1606	LAN	MSPCP-1600	MSP-1606 Permissive	I-105	PMCS-9110		
124	ZIO-1602	LAN	MSPCP-1600	MSP-1602 Check Valve Open	I-104	PMCS-9110		
125	ECI-1602	LAN	MSPCP-1600	MSP-1602 Control Voltage	I-104	PMCS-9110	0-150 V	
126	ECA-1602	LAN	MSPCP-1600	MSP-1602 Control Voltage Fail	I-104	PMCS-9110		
127	UA-1602B	LAN	MSPCP-1600	MSP-1602 Fault	I-104	PMCS-9110		
128	IA-1602	LAN	MSPCP-1600	MSP-1602 Motor Current Imbalance	I-104	PMCS-9110		
129	II-1602A	LAN	MSPCP-1600	MSP-1602 Motor Current Phase A	I-104	PMCS-9110	0-150 A	
130	II-1602B	LAN	MSPCP-1600	MSP-1602 Motor Current Phase B	I-104	PMCS-9110	0-150 A	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
131	II-1602C	LAN	MSPCP-1600	MSP-1602 Motor Current Phase C	I-104	PMCS-9110	0-150 A	
132	JKI-1602	LAN	MSPCP-1600	MSP-1602 Motor Energy	I-104	PMCS-9110	Σ kWh	
133	TAH-1602D	LAN	MSPCP-1600	MSP-1602 Motor Main Bearing Temperature	I-104	PMCS-9110	0-200 ºF	
134	JI-1602	LAN	MSPCP-1600	MSP-1602 Motor Power	I-104	PMCS-9110	0-100 kW	
135	JU-1602	LAN	MSPCP-1600	MSP-1602 Motor Power Factor	I-104	PMCS-9110	0-100%	
136	XA-1602A	LAN	MSPCP-1600	MSP-1602 Motor Stator Housing Leak	I-104	PMCS-9110		
137	TAH-1602E	LAN	MSPCP-1600	MSP-1602 Motor Support Bearing Temperature	I-104	PMCS-9110	0-200 ºF	
138	EA-1602	LAN	MSPCP-1600	MSP-1602 Motor Voltage Imbalance	I-104	PMCS-9110		
139	EI-1602A	LAN	MSPCP-1600	MSP-1602 Motor Voltage Phase A	I-104	PMCS-9110	0-600 V	
140	EI-1602B	LAN	MSPCP-1600	MSP-1602 Motor Voltage Phase B	I-104	PMCS-9110	0-600 V	
141	EI-1602C	LAN	MSPCP-1600	MSP-1602 Motor Voltage Phase C	I-104	PMCS-9110	0-600 V	
142	TAH-1602A	LAN	MSPCP-1600	MSP-1602 Motor Winding Temperature Phase A	I-104	PMCS-9110	0-200 ºF	
143	TAH-1602B	LAN	MSPCP-1600	MSP-1602 Motor Winding Temperature Phase B	I-104	PMCS-9110	0-200 ºF	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
144	TAH-1602C	LAN	MSPCP-1600	MSP-1602 Motor Winding Temperature Phase C	I-104	PMCS-9110	0-200 ºF	
145	QS-1602A	LAN	MSPCP-1600	MSP-1602 Not in Auto	I-104	PMCS-9110		
146	UAA-1602	LAN	MSPCP-1600	MSP-1602 Not in Service	I-104	PMCS-9110		
147	KI-1602S	LAN	MSPCP-1600	MSP-1602 Number of Starts	I-104	PMCS-9110		
148	QI-1602	LAN	MSPCP-1600	MSP-1602 On-Off	I-104	PMCS-9110		
149	UA-1602A	LAN	MSPCP-1600	MSP-1602 RVSS Fail/Motor Overload	I-104	PMCS-9110		
150	KI-1602R	LAN	MSPCP-1600	MSP-1602 Total Run Time	I-104	PMCS-9110	Σ hours	
151	VAH-1602X	LAN	MSPCP-1600	MSP-1602 Vibration X-Axis	I-104	PMCS-9110		
152	VAH-1602Y	LAN	MSPCP-1600	MSP-1602 Vibration Y-Axis	I-104	PMCS-9110		
153	VAH-1602Z	LAN	MSPCP-1600	MSP-1602 Vibration Z-Axis	I-104	PMCS-9110		
154	XA-1602D	LAN	MSPCP-1600	MSP-1602 Water in Oil	I-104	PMCS-9110		
155	AI-1603	LAN	MSPCP-1600	MSP-1603 Available	I-104	PMCS-9110		
156	ZIC-1603	LAN	MSPCP-1600	MSP-1603 Check Valve Closed	I-104	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
157	ZAC-1603	LAN	MSPCP-1600	MSP-1603 Check Valve Not Fully Closed	I-104	PMCS-9110		
158	ZAO-1603	LAN	MSPCP-1600	MSP-1603 Check Valve Not Fully Open	I-104	PMCS-9110		
159	ZIO-1603	LAN	MSPCP-1600	MSP-1603 Check Valve Open	I-104	PMCS-9110		
160	ECI-1603	LAN	MSPCP-1600	MSP-1603 Control Voltage	I-104	PMCS-9110	0-150 V	
161	ECA-1603	LAN	MSPCP-1600	MSP-1603 Control Voltage Fail	I-104	PMCS-9110		
162	PIR-1603	LAN	MSPCP-1600	MSP-1603 Discharge Pressure	I-104	PMCS-9110	0-100 psi	
163	UA-1603B	LAN	MSPCP-1600	MSP-1603 Fault	I-104	PMCS-9110		
164	IA-1603	LAN	MSPCP-1600	MSP-1603 Motor Current Imbalance	I-104	PMCS-9110		
165	II-1603A	LAN	MSPCP-1600	MSP-1603 Motor Current Phase A	I-104	PMCS-9110	0-150 A	
166	II-1603B	LAN	MSPCP-1600	MSP-1603 Motor Current Phase B	I-104	PMCS-9110	0-150 A	
167	II-1603C	LAN	MSPCP-1600	MSP-1603 Motor Current Phase C	I-104	PMCS-9110	0-150 A	
168	JKI-1603	LAN	MSPCP-1600	MSP-1603 Motor Energy	I-104	PMCS-9110	Σ kWh	
169	TAH-1603D	LAN	MSPCP-1600	MSP-1603 Motor Main Bearing Temperature	I-104	PMCS-9110	0-200 ºF	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
170	JI-1603	LAN	MSPCP-1600	MSP-1603 Motor Power	I-104	PMCS-9110	0-100 kW	
171	JU-1603	LAN	MSPCP-1600	MSP-1603 Motor Power Factor	I-104	PMCS-9110	0-100%	
172	XA-1603A	LAN	MSPCP-1600	MSP-1603 Motor Stator Housing Leak	I-104	PMCS-9110		
173	TAH-1603E	LAN	MSPCP-1600	MSP-1603 Motor Support Bearing Temperature	I-104	PMCS-9110	0-200 ºF	
174	EA-1603	LAN	MSPCP-1600	MSP-1603 Motor Voltage Imbalance	I-104	PMCS-9110		
175	EI-1603A	LAN	MSPCP-1600	MSP-1603 Motor Voltage Phase A	I-104	PMCS-9110	0-600 V	
176	EI-1603B	LAN	MSPCP-1600	MSP-1603 Motor Voltage Phase B	I-104	PMCS-9110	0-600 V	
177	EI-1603C	LAN	MSPCP-1600	MSP-1603 Motor Voltage Phase C	I-104	PMCS-9110	0-600 V	
178	TAH-1603A	LAN	MSPCP-1600	MSP-1603 Motor Winding Temperature Phase A	I-104	PMCS-9110	0-200 ºF	
179	TAH-1603B	LAN	MSPCP-1600	MSP-1603 Motor Winding Temperature Phase B	I-104	PMCS-9110	0-200 ºF	
180	TAH-1603C	LAN	MSPCP-1600	MSP-1603 Motor Winding Temperature Phase C	I-104	PMCS-9110	0-200 ºF	
181	QS-1603A	LAN	MSPCP-1600	MSP-1603 Not in Auto	I-104	PMCS-9110		
182	UAA-1603	LAN	MSPCP-1600	MSP-1603 Not in Service	I-104	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
183	KI-1603S	LAN	MSPCP-1600	MSP-1603 Number of Starts	I-104	PMCS-9110		
184	QI-1603	LAN	MSPCP-1600	MSP-1603 On-Off	I-104	PMCS-9110		
185	UA-1603A	LAN	MSPCP-1600	MSP-1603 RVSS Fail/Motor Overload	I-104	PMCS-9110		
186	KI-1603R	LAN	MSPCP-1600	MSP-1603 Total Run Time	I-104	PMCS-9110	Σ hours	
187	VAH-1603X	LAN	MSPCP-1600	MSP-1603 Vibration X-Axis	I-104	PMCS-9110		
188	VAH-160Y	LAN	MSPCP-1600	MSP-1603 Vibration Y-Axis	I-104	PMCS-9110		
189	VAH-1603Z	LAN	MSPCP-1600	MSP-1603 Vibration Z-Axis	I-104	PMCS-9110		
190	XA-1603B	LAN	MSPCP-1600	MSP-1603 Water in Oil	I-104	PMCS-9110		
191	AI-1604	LAN	MSPCP-1600	MSP-1604 Available	I-105	PMCS-9110		
192	ZIC-1604	LAN	MSPCP-1600	MSP-1604 Check Valve Closed	I-105	PMCS-9110		
193	ZAC-1604	LAN	MSPCP-1600	MSP-1604 Check Valve Not Fully Closed	I-105	PMCS-9110		
194	ZAO-1604	LAN	MSPCP-1600	MSP-1604 Check Valve Not Fully Open	I-105	PMCS-9110		
195	ZIO-1604	LAN	MSPCP-1600	MSP-1604 Check Valve Open	I-105	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
196	ECI-1604	LAN	MSPCP-1600	MSP-1604 Control Voltage	I-105	PMCS-9110	0-150 V	
197	ECA-1604	LAN	MSPCP-1600	MSP-1604 Control Voltage Fail	I-105	PMCS-9110		
198	PIR-1604	LAN	MSPCP-1600	MSP-1604 Discharge Pressure	I-105	PMCS-9110	0-100 psi	
199	UA-1604B	LAN	MSPCP-1600	MSP-1604 Fault	I-105	PMCS-9110		
200	IA-1604	LAN	MSPCP-1600	MSP-1604 Motor Current Imbalance	I-105	PMCS-9110		
201	II-1604A	LAN	MSPCP-1600	MSP-1604 Motor Current Phase A	I-105	PMCS-9110	0-150 A	
202	II-1604B	LAN	MSPCP-1600	MSP-1604 Motor Current Phase B	I-105	PMCS-9110	0-150 A	
203	II-1604C	LAN	MSPCP-1600	MSP-1604 Motor Current Phase C	I-105	PMCS-9110	0-150 A	
204	JKI-1604	LAN	MSPCP-1600	MSP-1604 Motor Energy	I-105	PMCS-9110	Σ kWh	
205	TAH-1604D	LAN	MSPCP-1600	MSP-1604 Motor Main Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
206	JI-1604	LAN	MSPCP-1600	MSP-1604 Motor Power	I-105	PMCS-9110	0-100 kW	
207	JU-1604	LAN	MSPCP-1600	MSP-1604 Motor Power Factor	I-105	PMCS-9110	0-100%	
208	XA-1604A	LAN	MSPCP-1600	MSP-1604 Motor Stator Housing Leak	I-105	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
209	TAH-1604E	LAN	MSPCP-1600	MSP-1604 Motor Support Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
210	EA-1604	LAN	MSPCP-1600	MSP-1604 Motor Voltage Imbalance	I-105	PMCS-9110		
211	EI-1604A	LAN	MSPCP-1600	MSP-1604 Motor Voltage Phase A	I-105	PMCS-9110	0-600 V	
212	EI-1604B	LAN	MSPCP-1600	MSP-1604 Motor Voltage Phase B	I-105	PMCS-9110	0-600 V	
213	EI-1604C	LAN	MSPCP-1600	MSP-1604 Motor Voltage Phase C	I-105	PMCS-9110	0-600 V	
214	TAH-1604A	LAN	MSPCP-1600	MSP-1604 Motor Winding Temperature Phase A	I-105	PMCS-9110	0-200 ºF	
215	TAH-1604B	LAN	MSPCP-1600	MSP-1604 Motor Winding Temperature Phase B	I-105	PMCS-9110	0-200 ºF	
216	TAH-1604C	LAN	MSPCP-1600	MSP-1604 Motor Winding Temperature Phase C	I-105	PMCS-9110	0-200 ºF	
217	QS-1604A	LAN	MSPCP-1600	MSP-1604 Not in Auto	I-105	PMCS-9110		
218	UAA-1604	LAN	MSPCP-1600	MSP-1604 Not in Service	I-105	PMCS-9110		
219	KI-1604S	LAN	MSPCP-1600	MSP-1604 Number of Starts	I-105	PMCS-9110		
220	QI-1604	LAN	MSPCP-1600	MSP-1604 On-Off	I-105	PMCS-9110		
221	UA-1604A	LAN	MSPCP-1600	MSP-1604 RVSS Fail/Motor Overload	I-105	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
222	KI-1604R	LAN	MSPCP-1600	MSP-1604 Total Run Time	I-105	PMCS-9110	Σ hours	
223	VAH-1604X	LAN	MSPCP-1600	MSP-1604 Vibration X-Axis	I-105	PMCS-9110		
224	VAH-1604Y	LAN	MSPCP-1600	MSP-1604 Vibration Y-Axis	I-105	PMCS-9110		
225	VAH-1604Z	LAN	MSPCP-1600	MSP-1604 Vibration Z-Axis	I-105	PMCS-9110		
226	XA-1604B	LAN	MSPCP-1600	MSP-1604 Water in Oil	I-105	PMCS-9110		
227	AI-1605	LAN	MSPCP-1600	MSP-1605 Available	I-105	PMCS-9110		
228	ZIC-1605	LAN	MSPCP-1600	MSP-1605 Check Valve Closed	I-105	PMCS-9110		
229	ZAC-1605	LAN	MSPCP-1600	MSP-1605 Check Valve Not Fully Closed	I-105	PMCS-9110		
230	ZAO-1605	LAN	MSPCP-1600	MSP-1605 Check Valve Not Fully Open	I-105	PMCS-9110		
231	ZIO-1605	LAN	MSPCP-1600	MSP-1605 Check Valve Open	I-105	PMCS-9110		
232	ECI-1605	LAN	MSPCP-1600	MSP-1605 Control Voltage	I-105	PMCS-9110	0-150 V	
233	ECA-1605	LAN	MSPCP-1600	MSP-1605 Control Voltage Fail	I-105	PMCS-9110		
234	PIR-1605	LAN	MSPCP-1600	MSP-1605 Discharge Pressure	I-105	PMCS-9110	0-100 psi	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
235	UA-1605B	LAN	MSPCP-1600	MSP-1605 Fault	I-105	PMCS-9110		
236	IA-1605A	LAN	MSPCP-1600	MSP-1605 Motor Current Imbalance	I-105	PMCS-9110		
237	II-1605AA	LAN	MSPCP-1600	MSP-1605 Motor Current Phase A	I-105	PMCS-9110	0-150 A	
238	II-1605AB	LAN	MSPCP-1600	MSP-1605 Motor Current Phase B	I-105	PMCS-9110	0-150 A	
239	II-1605AC	LAN	MSPCP-1600	MSP-1605 Motor Current Phase C	I-105	PMCS-9110	0-150 A	
240	JKI-1605A	LAN	MSPCP-1600	MSP-1605 Motor Energy	I-105	PMCS-9110	Σ kWh	
241	TAH-1605E	LAN	MSPCP-1600	MSP-1605 Motor Main Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
242	JI-1605A	LAN	MSPCP-1600	MSP-1605 Motor Power	I-105	PMCS-9110	0-100 kW	
243	JU-1605A	LAN	MSPCP-1600	MSP-1605 Motor Power Factor	I-105	PMCS-9110	0-100%	
244	XA-1605A	LAN	MSPCP-1600	MSP-1605 Motor Stator Housing Leak	I-105	PMCS-9110		
245	TAH-1605E	LAN	MSPCP-1600	MSP-1605 Motor Support Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
246	EI-1605A	LAN	MSPCP-1600	MSP-1605 Motor Voltage Phase A	I-105	PMCS-9110	0-600 V	
247	EI-1605B	LAN	MSPCP-1600	MSP-1605 Motor Voltage Phase B	I-105	PMCS-9110	0-600 V	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
248	EI-1605C	LAN	MSPCP-1600	MSP-1605 Motor Voltage Phase C	I-105	PMCS-9110	0-600 V	
249	TAH-1605A	LAN	MSPCP-1600	MSP-1605 Motor Winding Temperature Phase A	I-105	PMCS-9110	0-200 ºF	
250	TAH-1605B	LAN	MSPCP-1600	MSP-1605 Motor Winding Temperature Phase B	I-105	PMCS-9110	0-200 ºF	
251	TAH-1605C	LAN	MSPCP-1600	MSP-1605 Motor Winding Temperature Phase C	I-105	PMCS-9110	0-200 ºF	
252	QS-1605A	LAN	MSPCP-1600	MSP-1605 Not in Auto	I-105	PMCS-9110		
253	UAA-1605	LAN	MSPCP-1600	MSP-1605 Not in Service	I-105	PMCS-9110		
254	KI-1605S	LAN	MSPCP-1600	MSP-1605 Number of Starts	I-105	PMCS-9110		
255	QI-1605	LAN	MSPCP-1600	MSP-1605 On-Off	I-105	PMCS-9110		
256	UA-1605A	LAN	MSPCP-1600	MSP-1605 RVSS Fail/Motor Overload	I-105	PMCS-9110		
257	KI-1605R	LAN	MSPCP-1600	MSP-1605 Total Run Time	I-105	PMCS-9110	Σ hours	
258	VAH-1605X	LAN	MSPCP-1600	MSP-1605 Vibration X-Axis	I-105	PMCS-9110		
259	VAH-1605Y	LAN	MSPCP-1600	MSP-1605 Vibration Y-Axis	I-105	PMCS-9110		
260	VAH-1605Z	LAN	MSPCP-1600	MSP-1605 Vibration Z-Axis	I-105	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
261	XA-1605B	LAN	MSPCP-1600	MSP-1605 Water in Oil	I-105	PMCS-9110		
262	AI-1606A	LAN	MSPCP-1600	MSP-1606 Available	I-105	PMCS-9110		
263	ZIC-1606A	LAN	MSPCP-1600	MSP-1606 Check Valve Closed	I-105	PMCS-9110		
264	ZAC-1606A	LAN	MSPCP-1600	MSP-1606 Check Valve Not Fully Closed	I-105	PMCS-9110		
265	ZAO-1606A	LAN	MSPCP-1600	MSP-1606 Check Valve Not Fully Open	I-105	PMCS-9110		
266	ZIO-1606A	LAN	MSPCP-1600	MSP-1606 Check Valve Open	I-105	PMCS-9110		
267	ECI-1606A	LAN	MSPCP-1600	MSP-1606 Control Voltage	I-105	PMCS-9110	0-150 V	
268	ECA-1606A	LAN	MSPCP-1600	MSP-1606 Control Voltage Fail	I-105	PMCS-9110		
269	PIR-1606	LAN	MSPCP-1600	MSP-1606 Discharge Pressure	I-105	PMCS-9110	0-100 psi	
270	XA-1606K	LAN	MSPCP-1600	MSP-1606 Discharge Valve Fail	I-105	PMCS-9110		
271	UA-1606B	LAN	MSPCP-1600	MSP-1606 Fault	I-105	PMCS-9110		
272	IA-1606	LAN	MSPCP-1600	MSP-1606 Motor Current Imbalance	I-105	PMCS-9110		
273	II-1606A	LAN	MSPCP-1600	MSP-1606 Motor Current Phase A	I-105	PMCS-9110	0-150 A	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
274	II-1606B	LAN	MSPCP-1600	MSP-1606 Motor Current Phase B	I-105	PMCS-9110	0-150 A	
275	II-1606C	LAN	MSPCP-1600	MSP-1606 Motor Current Phase C	I-105	PMCS-9110	0-150 A	
276	JKI-1606	LAN	MSPCP-1600	MSP-1606 Motor Energy	I-105	PMCS-9110	Σ kWh	
277	TAH-1606D	LAN	MSPCP-1600	MSP-1606 Motor Main Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
278	JI-1606	LAN	MSPCP-1600	MSP-1606 Motor Power	I-105	PMCS-9110	0-100 kW	
279	JU-1606	LAN	MSPCP-1600	MSP-1606 Motor Power Factor	I-105	PMCS-9110	0-100%	
280	XA-1606A	LAN	MSPCP-1600	MSP-1606 Motor Stator Housing Leak	I-105	PMCS-9110		
281	TAH-1606E	LAN	MSPCP-1600	MSP-1606 Motor Support Bearing Temperature	I-105	PMCS-9110	0-200 ºF	
282	EA-1606	LAN	MSPCP-1600	MSP-1606 Motor Voltage Imbalance	I-105	PMCS-9110		
283	EI-1606A	LAN	MSPCP-1600	MSP-1606 Motor Voltage Phase A	I-105	PMCS-9110	0-600 V	
284	EI-1606B	LAN	MSPCP-1600	MSP-1606 Motor Voltage Phase B	I-105	PMCS-9110	0-600 V	
285	EI-1606C	LAN	MSPCP-1600	MSP-1606 Motor Voltage Phase C	I-105	PMCS-9110	0-600 V	
286	TAH-1606A	LAN	MSPCP-1600	MSP-1606 Motor Winding Temperature Phase A	I-105	PMCS-9110	0-200 ºF	

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
287	TAH-1606B	LAN	MSPCP-1600	MSP-1606 Motor Winding Temperature Phase B	I-105	PMCS-9110	0-200 ºF	
288	TAH-1606C	LAN	MSPCP-1600	MSP-1606 Motor Winding Temperature Phase C	I-105	PMCS-9110	0-200 ºF	
289	QS-1606A	LAN	MSPCP-1600	MSP-1606 Not in Auto	I-105	PMCS-9110		
290	UAA-1606	LAN	MSPCP-1600	MSP-1606 Not in Service	I-105	PMCS-9110		
291	KI-1606S	LAN	MSPCP-1600	MSP-1606 Number of Starts	I-105	PMCS-9110		
292	QI-1606	LAN	MSPCP-1600	MSP-1606 On-Off	I-105	PMCS-9110		
293	UA-1606A	LAN	MSPCP-1600	MSP-1606 RVSS Fail/Motor Overload	I-105	PMCS-9110		
294	KI-1606R	LAN	MSPCP-1600	MSP-1606 Total Run Time	I-105	PMCS-9110	Σ hours	
295	VAH-1606X	LAN	MSPCP-1600	MSP-1606 Vibration X-Axis	I-105	PMCS-9110		
296	VAH-1606Y	LAN	MSPCP-1600	MSP-1606 Vibration Y-Axis	I-105	PMCS-9110		
297	VAH-1606Z	LAN	MSPCP-1600	MSP-1606 Vibration Z-Axis	I-105	PMCS-9110		
298	XA-1606B	LAN	MSPCP-1600	MSP-1606 Water in Oil	I-105	PMCS-9110		
299	LAH-027	LAN	MSPCP-1600	Wet Well Level High Primary	I-103	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
300	LAH-028	LAN	MSPCP-1600	Wet Well Level High Secondary	I-103	PMCS-9110		
301	LAHH-027	LAN	MSPCP-1600	Wet Well Level High-High Primary	I-103	PMCS-9110		
302	LAHH-028	LAN	MSPCP-1600	Wet Well Level High-High Secondary	I-103	PMCS-9110		
303	LAL-027	LAN	MSPCP-1600	Wet Well Level Low Primary	I-103	PMCS-9110		
304	LAL-028	LAN	MSPCP-1600	Wet Well Level Low Secondary	I-103	PMCS-9110		
305	LALL-027	LAN	MSPCP-1600	Wet Well Level Low-Low Primary	I-103	PMCS-9110		
306	LALL-028	LAN	MSPCP-1600	Wet Well Level Low-Low Secondary	I-103	PMCS-9110		
307	LIR-027	LAN	MSPCP-1600	Wet Well Level Primary	I-103	PMCS-9110	0-14 feet	
308	LIR-028	LAN	MSPCP-1600	Wet Well Level Secondary	I-103	PMCS-9110	0-14 feet	
309	XA-1600R	LAN	RPS-1600	MSPCP 24VDC RPS Fault	I-101	PMCS-9110		
310	XA-1600U	LAN	UPS-1600	MSPCP UPS Fault	I-101	PMCS-9110		
311	VAL-7401	DI	LCP-7401-C	Vacuum Primer VP-7401 Low Vacuum	I-106	MSPCP-1600		
312	XA-7401	DI	LCP-7401-C	Vacuum Primer VP-7401 PLC Failure	I-106	MSPCP-1600		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
313	LAH-7401	LAN	LCP-7401-C	VP-7401 Receiver Tank High Water Level	I-106	MSPCP-1600		
314	KI-7401AR	LAN	LCP-7401-C	VP-7401A Vacuum Pump Run Time	I-106	MSPCP-1600		
315	QI-7401AA	LAN	LCP-7401-C	VP-7401A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
316	IAH-7401A	LAN	LCP-7401-C	VP-7401A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
317	PAL-7401AA	LAN	LCP-7401-C	VP-7401A Low Oil Pressure	I-106	MSPCP-1600		
318	QI-7401AB	LAN	LCP-7401-C	VP-7401A Not in Auto	I-106	MSPCP-1600		
319	KI-7401BR	LAN	LCP-7401-C	VP-7401B Vacuum Pump Run Time	I-106	MSPCP-1600		
320	QI-7401BA	LAN	LCP-7401-C	VP-7401B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
321	IAH-7401B	LAN	LCP-7401-C	VP-7401B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
322	PAL-7401BA	LAN	LCP-7401-C	VP-7401B Low Oil Pressure	I-106	MSPCP-1600		
323	QI-7401BB	LAN	LCP-7401-C	VP-7401B Not in Auto	I-106	MSPCP-1600		
324	VAL-7402	DI	LCP-7402-C	Vacuum Primer VP-7402 Low Vacuum	I-106	MSPCP-1600		
325	XA-7402	DI	LCP-7402-C	Vacuum Primer VP-7402 PLC Failure	I-106	MSPCP-1600		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
326	LAH-7402	LAN	LCP-7402-C	VP-7402 Receiver Tank High Water Level	I-106	MSPCP-1600		
327	KI-7402AR	LAN	LCP-7402-C	VP-7402A Vacuum Pump Run Time	I-106	MSPCP-1600		
328	QI-7402AB	LAN	LCP-7402-C	VP-7402A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
329	IAH-7402A	LAN	LCP-7402-C	VP-7402A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
330	PAL-7402A	LAN	LCP-7402-C	VP-7402A Low Oil Pressure	I-106	MSPCP-1600		
331	QI-7402AB	LAN	LCP-7402-C	VP-7402A Not in Auto	I-106	MSPCP-1600		
332	KI-7402BR	LAN	LCP-7402-C	VP-7402B Vacuum Pump Run Time	I-106	MSPCP-1600		
333	QI-7402BB	LAN	LCP-7402-C	VP-7402B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
334	IAH-7402B	LAN	LCP-7402-C	VP-7402B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
335	PAL-7402B	LAN	LCP-7402-C	VP-7402B Low Oil Pressure	I-106	MSPCP-1600		
336	QI-7402BB	LAN	LCP-7402-C	VP-7402B Not in Auto	I-106	MSPCP-1600		
337	VAL-7403	DI	LCP-7403-C	Vacuum Primer VP-7403 Low Vacuum	I-106	MSPCP-1600		
338	XA-7403	DI	LCP-7403-C	Vacuum Primer VP-7403 PLC Failure	I-106	MSPCP-1600		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
339	LAH-7403	LAN	LCP-7403-C	VP-7403 Receiver Tank High Water Level	I-106	MSPCP-1600		
340	KI-7403AR	LAN	LCP-7403-C	VP-7403A Vacuum Pump Run Time	I-106	MSPCP-1600		
341	QI-7403AB	LAN	LCP-7403-C	VP-7403A Vacuum Pump On/Off Status	I-106	MSPCP-1600		
342	IAH-7403A	LAN	LCP-7403-C	VP-7403A Vacuum Pump Motor Overload	I-106	MSPCP-1600		
343	PAL-7403A	LAN	LCP-7403-C	VP-7403A Low Oil Pressure	I-106	MSPCP-1600		
344	QI-7403AB	LAN	LCP-7403-C	VP-7403A Not in Auto	I-106	MSPCP-1600		
345	KI-7403BR	LAN	LCP-7403-C	VP-7403B Vacuum Pump Run Time	I-106	MSPCP-1600		
346	QI-7403BB	LAN	LCP-7403-C	VP-7403B Vacuum Pump On/Off Status	I-106	MSPCP-1600		
347	IAH-7403B	LAN	LCP-7403-C	VP-7403B Vacuum Pump Motor Overload	I-106	MSPCP-1600		
348	PAL-7403B	LAN	LCP-7403-C	VP-7403B Low Oil Pressure	I-106	MSPCP-1600		
349	QI-7403BB	LAN	LCP-7403-C	VP-7403B Not in Auto	I-106	MSPCP-1600		
350	XA-9130R	LAN	RPS-9130	RTU 24VDC Fault	I-101	PMCS-9110		
351	XA-9130U	LAN	UPS-9130	RTU UPS Fault	I-101	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
352	52-1N-P	DI	EMCS-1510	SERVICE NO. 1, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
353	52-1N-P	DI	EMCS-1510	SERVICE NO. 1, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
354	52-1N-S	DI	EMCS-1510	SERVICE NO. 1, SECONDARY MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
355	52-1N-S	DI	EMCS-1510	SERVICE NO. 1, SECONDARY MAIN BREAKER TRIPPED	I-101	PMCS-9110		
356	52-2N	DI	EMCS-1510	SERVICE NO. 2, MAIN BREAKER OPENED/CLOSED	I-101	PMCS-9110		
357	52-2N	DI	EMCS-1510	SERVICE NO. 2, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
358	ATS-1A	DI	EMCS-1510	ATS-1A NORMAL SIDE	I-101	PMCS-9110		
359	ATS-1A	DI	EMCS-1510	ATS-1A EMERGENCY SIDE	I-101	PMCS-9110		
360	ATS-1B	DI	EMCS-1510	ATS-1B NORMAL SIDE	I-101	PMCS-9110		
361	ATS-1B	DI	EMCS-1510	ATS-1B EMERGENCY SIDE	I-101	PMCS-9110		
362	PM-1	LAN	EMCS-1510	MCC-1A POWER MONITOR SERVICE NO. 1 - V, A, kW, kVAR, kVA, PF, THD	I-101	PMCS-9110		
363	52-1A	DI	EMCS-1510	MCC-1A, MAIN BREAKER MCC BUS A, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
364	52-1A	DI	EMCS-1510	MCC-1A, MAIN BREAKER MCC BUS A, MAIN BREAKER TRIPPED	I-101	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
365	52-TA	DI	EMCS-1510	MCC-1A, TIE BREAKER OPEN/CLOSED	I-101	PMCS-9110		
366	52-TA	DI	EMCS-1510	MCC-1A, TIE BREAKER TRIPPED	I-101	PMCS-9110		
367	52-TB	DI	EMCS-1510	MCC-1B, TIE BREAKER OPEN/CLOSED	I-101	PMCS-9110		
368	52-TB	DI	EMCS-1510	MCC-1B, TIE BREAKER TRIPPED	I-101	PMCS-9110		
369	PM-2	LAN	EMCS-1510	MCC-1B, POWER MONITOR SERVICE NO. 2 - V, A, kW, kVAR, kVA, PF, THD	I-101	PMCS-9110		
370	52-1B	DI	EMCS-1510	MCC-1B, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
371	52-1B	DI	EMCS-1510	MCC-1B, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
372	52-1E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, STANDBY GENERATOR BREAKER OPENED/CLOSED	I-101	PMCS-9110		
373	52-1E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, STANDBY GENERATOR BREAKER TRIPPED	I-101	PMCS-9110		
374	52-2E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, PORTABLE GENERATOR BREAKER OPENED/CLOSED	I-101	PMCS-9110		
375	52-2E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, PORTABLE GENERATOR BREAKER TRIPPED	I-101	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
376	QI-8511	LAN	GMCP-8510	GENERATOR RUNNING	I-101	PMCS-9110		
377	JI-8512	LAN	GMCP-8510	GENERATOR POWER METERING - V, A, kW, kVA, PF, F	I-101	PMCS-9110		
378	UC-8513	LAN	GMCP-8510	GENERATOR START/STOP	I-101	PMCS-9110		
379	UC-8514	LAN	GMCP-8510	GENERATOR EMERGENCY STOP	I-101	PMCS-9110		
380	XAH-8515	LAN	GMCP-8510	GENERATOR OVERCRANK SHUTDOWN	I-101	PMCS-9110		
381	TAH-8516	LAN	GMCP-8510	GENERATOR HIGH ENGINE TEMP SHUTDOWN	I-101	PMCS-9110		
382	PAL-8517	LAN	GMCP-8510	GENERATOR LOW LUBE OIL PRES SHUTDOWN	I-101	PMCS-9110		
383	SAH-8518	LAN	GMCP-8510	GENERATOR OVERSPEED SHUTDOWN	I-101	PMCS-9110		
384	XAH-8519	LAN	GMCP-8510	GENERATOR OVERCRANK WARNING	I-101	PMCS-9110		
385	TAH-8520	LAN	GMCP-8510	GENERATOR HIGH ENGINE TEMP WARNING	I-101	PMCS-9110		
386	PAL-8521	LAN	GMCP-8510	GENERATOR LOW LUBE OIL PRES WARNING	I-101	PMCS-9110		
387	SAH-8522	LAN	GMCP-8510	GENERATOR OVERSPEED WARNING	I-101	PMCS-9110		
388	LAL-8523	LAN	GMCP-8510	GENERATOR COOLANT LOW LEVEL	I-101	PMCS-9110		

Table 2 - Input/Output List - PMCS-9110

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
389	EAH-8524	LAN	GMCP-8510	GENERATOR BATTERY HIGH VOLTAGE	I-101	PMCS-9110		
390	EAL-8525	LAN	GMCP-8510	GENERATOR BATTERY LOW CRANKING VOLTAGE	I-101	PMCS-9110		
391	EAL-8526	LAN	GMCP-8510	GENERATOR BATTERY LOW VOLTAGE	I-101	PMCS-9110		
392	EAL-8527	LAN	GMCP-8510	GENERATOR BATTERY CHARGER AC FAILURE	I-101	PMCS-9110	0-14 feet	
393	HC-8528	LAN	GMCP-8510	GENERATOR LAMP TEST	I-101	PMCS-9110		
394	LIR-026	AI	LT-026	Ralph Avenue Inlet Bypass Chamber Flow (Level)	I-103	PMCS-9110	0-14 feet	
395	LAH-026	LAN	LT-026	Ralph Avenue Sewer Level High Alarm	I-103	PMCS-9110		
396	XA-7798	DI	LCP-7798	Sump Pump SP-8 Fault	I-108	PMCS-9110	-	
397	LAHH-7798	DI	Float Switch	Sump Pit 8 High Level/Flooding	I-108	PMCS-9110	-	

PHYSICAL I/O COUNT - PMCS-9110			
I/O Type	Used	Spare	Required
AI	15	4	19
AO	1	0	1
DI	66	17	83
DO	10	3	13

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
1	LALL-030	DI	BSCP-9120	Wet Well Level Low-Low	I-103	RTU-9130		
2	LAL-030	DI	BSCP-9120	Wet Well Level Low-Low	I-103	RTU-9130		
3	LAH-030	DI	BSCP-9120	Wet Well Level Low-Low	I-103	RTU-9130		
4	LAHH-030	DI	BSCP-9120	Wet Well Level High-High	I-103	RTU-9130		
5	QI-030A	DI	BSCP-9120	Backup System Active	I-103	RTU-9130		
6	QA-030A	DI	BSCP-9120	Backup Not in Auto	I-103	RTU-9130		
7	XA-9130U	DI	RTU UPS	RTU UPS Fault	I-101	RTU-9130		
8	XA-9130R	DI	RTU RPS	RTU 24VDC RPS Fault	I-101	RTU-9130		
9	FIR-026	LAN	PMCS-9110	Ralph Avenue Flow ≥ 50 mgd	I-103	RTU-9130		
10	XA-1301A	LAN	PMCS-9110	Ralph Avenue Inlet Gate Jam	I-103	RTU-9130		
11	XA-1302A	LAN	PMCS-9110	Avenue M Inlet Gate Jam	I-103	RTU-9130		
12	PIR-1602	LAN	PMCS-9110	MSP-1602 Discharge Pressure	I-104	RTU-9130	0-15 psi	
13	ZI-1301A	LAN	PMCS-9110	Ralph Avenue Inlet Gate Position	I-103	RTU-9130		
14	ZI-1302A	LAN	PMCS-9110	Avenue M Inlet Gate Position	I-103	RTU-9130		
15	FIRQ-1610H	LAN	PMCS-9110	High Service Header Flow Rate & Total Flow	I-104	RTU-9130	0-40 mgd	
16	FIRQ-1610L	LAN	PMCS-9110	Low Service Header Flow Rate & Total Flow	I-105	RTU-9130	0-40 mgd	
17	AAH-120	LAN	PMCS-9110	35% LEL CH4 / H2S in Wet Well	I-103	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
18	PIR-1610H	LAN	PMCS-9110	High Service Header Pressure	I-104	RTU-9130	0-15 psi	
19	AAH-140	LAN	PMCS-9110	35% LEL CH4 / H2S in Screen Chamber	I-103	RTU-9130		
20	PIR-1610L	LAN	PMCS-9110	High Service Header Pressure	I-105	RTU-9130	0-15 psi	
21	QI-1601P	LAN	PMCS-9110	MSP-1601 Proof of Prime	I-104	RTU-9130		
22	QI-1602P	LAN	PMCS-9110	MSP-1602 Proof of Prime	I-104	RTU-9130		
23	QI-1603P	LAN	PMCS-9110	MSP-1603 Proof of Prime	I-104	RTU-9130		
24	AAHH-120	LAN	PMCS-9110	60% LEL CH4 / H2S in Wet Well	I-103	RTU-9130		
25	AAHH-140	LAN	PMCS-9110	60% LEL CH4 / H2S in Screen Chamber	I-103	RTU-9130		
26	IAH-1601	LAN	PMCS-9110	MSP-1601 Bypass Starter Overload	I-104	RTU-9130		
27	IAH-1602	LAN	PMCS-9110	MSP-1602 Bypass Starter Overload	I-104	RTU-9130		
28	IAH-1603	LAN	PMCS-9110	MSP-1603 Bypass Starter Overload	I-104	RTU-9130		
29	IAH-1604	LAN	PMCS-9110	MSP-1604 Bypass Starter Overload	I-105	RTU-9130		
30	IAH-1605	LAN	PMCS-9110	MSP-1605 Bypass Starter Overload	I-105	RTU-9130		
31	IAH-1606	LAN	PMCS-9110	MSP-1606 Bypass Starter Overload	I-105	RTU-9130		
32	AI-1601	LAN	PMCS-9110	MSP-1601 Available	I-104	RTU-9130		
33	ZIC-1601	LAN	PMCS-9110	MSP-1601 Check Valve Closed	I-104	RTU-9130		
34	ZAC-1601	LAN	PMCS-9110	MSP-1601 Check Valve Not Fully Closed	I-104	RTU-9130		
35	ZAO-1601	LAN	PMCS-9110	MSP-1601 Check Valve Not Fully Open	I-104	RTU-9130		
36	ZIO-1601	LAN	PMCS-9110	MSP-1601 Check Valve Open	I-104	RTU-9130		
37	ECI-1601	LAN	PMCS-9110	MSP-1601 Control Voltage	I-104	RTU-9130	0-150 V	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
38	ECA-1601	LAN	PMCS-9110	MSP-1601 Control Voltage Fail	I-104	RTU-9130		
39	PIR-1601	LAN	PMCS-9110	MSP-1601 Discharge Pressure	I-104	RTU-9130	0-100 psi	
40	UA-1601A	LAN	PMCS-9110	MSP-1601 Fault	I-104	RTU-9130		
41	IA-1601	LAN	PMCS-9110	MSP-1601 Motor Current Imbalance	I-104	RTU-9130		
42	II-1601A	LAN	PMCS-9110	MSP-1601 Motor Current Phase A	I-104	RTU-9130	0-150 A	
43	II-1601B	LAN	PMCS-9110	MSP-1601 Motor Current Phase B	I-104	RTU-9130	0-150 A	
44	II-1601C	LAN	PMCS-9110	MSP-1601 Motor Current Phase C	I-104	RTU-9130	0-150 A	
45	JKI-1601	LAN	PMCS-9110	MSP-1601 Motor Energy	I-104	RTU-9130	Σ kWh	
46	TAH-1601D	LAN	PMCS-9110	MSP-1601 Motor Main Bearing Temperature	I-104	RTU-9130	0-200 ºF	
47	JI-1601	LAN	PMCS-9110	MSP-1601 Motor Power	I-104	RTU-9130	0-100 kW	
48	JU-1601	LAN	PMCS-9110	MSP-1601 Motor Power Factor	I-104	RTU-9130	0-100%	
49	XA-1601A	LAN	PMCS-9110	MSP-1601 Motor Stator Housing Leak	I-104	RTU-9130		
50	TAH-1601E	LAN	PMCS-9110	MSP-1601 Motor Support Bearing Temperature	I-104	RTU-9130	0-200 ºF	
51	EA-1601	LAN	PMCS-9110	MSP-1601 Motor Voltage Imbalance	I-104	RTU-9130		
52	EI-1601A	LAN	PMCS-9110	MSP-1601 Motor Voltage Phase A	I-104	RTU-9130	0-600 V	
53	EI-1601B	LAN	PMCS-9110	MSP-1601 Motor Voltage Phase B	I-104	RTU-9130	0-600 V	
54	EI-1601C	LAN	PMCS-9110	MSP-1601 Motor Voltage Phase C	I-104	RTU-9130	0-600 V	
55	TAH-1601A	LAN	PMCS-9110	MSP-1601 Motor Winding Temperature Phase A	I-104	RTU-9130	0-200 ºF	
56	TAH-1601B	LAN	PMCS-9110	MSP-1601 Motor Winding Temperature Phase B	I-104	RTU-9130	0-200 ºF	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
57	TAH-1601C	LAN	PMCS-9110	MSP-1601 Motor Winding Temperature Phase C	I-104	RTU-9130	0-200 ºF	
58	QS-1601	LAN	PMCS-9110	MSP-1601 Not in Auto	I-104	RTU-9130		
59	UAA-1601	LAN	PMCS-9110	MSP-1601 Not in Service	I-104	RTU-9130		
60	KI-1601S	LAN	PMCS-9110	MSP-1601 Number of Starts	I-104	RTU-9130		
61	QI-1601	LAN	PMCS-9110	MSP-1601 On-Off	I-104	RTU-9130		
62	UA-1601B	LAN	PMCS-9110	MSP-1601 RVSS Fail/Motor Overload	I-104	RTU-9130		
63	UA-1601C	LAN	PMCS-9110	MSP-1601 Alarm	I-104	RTU-9130		
64	UA-1602C	LAN	PMCS-9110	MSP-1602 Alarm	I-104	RTU-9130		
65	UA-1603C	LAN	PMCS-9110	MSP-1603 Alarm	I-104	RTU-9130		
66	UA-1604C	LAN	PMCS-9110	MSP-1604 Alarm	I-105	RTU-9130		
67	KI-1601R	LAN	PMCS-9110	MSP-1601 Total Run Time	I-104	RTU-9130	Σ hours	
68	VAH-1601X	LAN	PMCS-9110	MSP-1601 Vibration X-Axis	I-104	RTU-9130		
69	VAH-1601Y	LAN	PMCS-9110	MSP-1601 Vibration Y-Axis	I-104	RTU-9130		
70	UA-1605C	LAN	PMCS-9110	MSP-1605 Alarm	I-105	RTU-9130		
71	VAH-1601Z	LAN	PMCS-9110	MSP-1601 Vibration Z-Axis	I-104	RTU-9130		
72	XA-1601B	LAN	PMCS-9110	MSP-1601 Water in Oil	I-104	RTU-9130		
73	AI-1602	LAN	PMCS-9110	MSP-1602 Available	I-104	RTU-9130		
74	BU-1601	LAN	PMCS-9110	MSP-1601 Permissive	I-104	RTU-9130		
75	BU-1602	LAN	PMCS-9110	MSP-1602 Permissive	I-104	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
76	BU-1603	LAN	PMCS-9110	MSP-1603 Permissive	I-104	RTU-9130		
77	BU-1604	LAN	PMCS-9110	MSP-1604 Permissive	I-105	RTU-9130		
78	ZIC-1602	LAN	PMCS-9110	MSP-1602 Check Valve Closed	I-104	RTU-9130		
79	ZAC-1602	LAN	PMCS-9110	MSP-1602 Check Valve Not Fully Closed	I-104	RTU-9130		
80	ZAO-1602	LAN	PMCS-9110	MSP-1602 Check Valve Not Fully Open	I-104	RTU-9130		
81	UA-7401C	LAN	PMCS-9110	VP-7401 System Malfunction	I-106	RTU-9130		
82	BU-1605	LAN	PMCS-9110	MSP-1605 Permissive	I-105	RTU-9130		
83	QI-7401A	LAN	PMCS-9110	VP-7401A Vacuum Pump On/Off	I-106	RTU-9130		
84	BU-1606	LAN	PMCS-9110	MSP-1606 Permissive	I-105	RTU-9130		
85	UA-7401AE	LAN	PMCS-9110	VP-7401A Vacuum Pump Fail	I-106	RTU-9130		
86	ZIO-1602	LAN	PMCS-9110	MSP-1602 Check Valve Open	I-104	RTU-9130		
87	QI-7401B	LAN	PMCS-9110	VP-7401B Vacuum Pump On/Off	I-106	RTU-9130		
88	ECI-1602	LAN	PMCS-9110	MSP-1602 Control Voltage	I-104	RTU-9130	0-150 V	
89	UA-7401BE	LAN	PMCS-9110	VP-7401B Vacuum Pump Fail	I-106	RTU-9130		
90	ECA-1602	LAN	PMCS-9110	MSP-1602 Control Voltage Fail	I-104	RTU-9130		
91	UA-7402C	LAN	PMCS-9110	VP-7402 System Malfunction	I-106	RTU-9130		
92	UA-1602B	LAN	PMCS-9110	MSP-1602 Fault	I-104	RTU-9130		
93	QI-7402A	LAN	PMCS-9110	VP-7402A Vacuum Pump On/Off	I-106	RTU-9130		
94	IA-1602	LAN	PMCS-9110	MSP-1602 Motor Current Imbalance	I-104	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
95	UA-7402A	LAN	PMCS-9110	VP-7402A Vacuum Pump Fail	I-106	RTU-9130		
96	II-1602A	LAN	PMCS-9110	MSP-1602 Motor Current Phase A	I-104	RTU-9130	0-150 A	
97	QI-7402B	LAN	PMCS-9110	VP-7402B Vacuum Pump On/Off	I-106	RTU-9130		
98	II-1602B	LAN	PMCS-9110	MSP-1602 Motor Current Phase B	I-104	RTU-9130	0-150 A	
99	UA-7402B	LAN	PMCS-9110	VP-7402B Vacuum Pump Fail	I-106	RTU-9130		
100	II-1602C	LAN	PMCS-9110	MSP-1602 Motor Current Phase C	I-104	RTU-9130	0-150 A	
101	UA-7403C	LAN	PMCS-9110	VP-7403 System Malfunction	I-106	RTU-9130		
102	JKI-1602	LAN	PMCS-9110	MSP-1602 Motor Energy	I-104	RTU-9130	Σ kWh	
103	QI-7403A	LAN	PMCS-9110	VP-7403A Vacuum Pump On/Off	I-106	RTU-9130		
104	TAH-1602D	LAN	PMCS-9110	MSP-1602 Motor Main Bearing Temperature	I-104	RTU-9130	0-200 ºF	
105	UA-7403A	LAN	PMCS-9110	VP-7403A Vacuum Pump Fail	I-106	RTU-9130		
106	JI-1602	LAN	PMCS-9110	MSP-1602 Motor Power	I-104	RTU-9130	0-100 kW	
107	QI-7403B	LAN	PMCS-9110	VP-7403B Vacuum Pump On/Off	I-106	RTU-9130		
108	JU-1602	LAN	PMCS-9110	MSP-1602 Motor Power Factor	I-104	RTU-9130	0-100%	
109	UA-7403B	LAN	PMCS-9110	VP-7403B Vacuum Pump Fail	I-106	RTU-9130		
110	XA-1602A	LAN	PMCS-9110	MSP-1602 Motor Stator Housing Leak	I-104	RTU-9130		
111	PAL-7601	LAN	PSL-7601	Service Water Low Pressure	I-107	RTU-9130		
112	TAH-1602E	LAN	PMCS-9110	MSP-1602 Motor Support Bearing Temperature	I-104	RTU-9130	0-200 ºF	
113	XA-8101	LAN	FACP-8100	Trouble Alarm	I-107	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
114	EA-1602	LAN	PMCS-9110	MSP-1602 Motor Voltage Imbalance	I-104	RTU-9130		
115	UA-8101	LAN	FACP-8100	Fire Alarm	I-107	RTU-9130		
116	EI-1602A	LAN	PMCS-9110	MSP-1602 Motor Voltage Phase A	I-104	RTU-9130	0-600 V	
117	XA-8101A	LAN	FACP-8100	Supervisory Alarm	I-107	RTU-9130		
118	EI-1602B	LAN	PMCS-9110	MSP-1602 Motor Voltage Phase B	I-104	RTU-9130	0-600 V	
119	UA-7301	LAN	ATC-1	HVAC Alarm - Screening Chamber	I-107	RTU-9130		
120	EI-1602C	LAN	PMCS-9110	MSP-1602 Motor Voltage Phase C	I-104	RTU-9130	0-600 V	
121	UA-7302	LAN	ATC-2	HVAC Alarm - Wet Well	I-107	RTU-9130		
122	TAH-1602A	LAN	PMCS-9110	MSP-1602 Motor Winding Temperature Phase A	I-104	RTU-9130	0-200 ºF	
123	UA-7303	LAN	ATC-3	HVAC Alarm - Dry Well	I-107	RTU-9130		
124	TAH-1602B	LAN	PMCS-9110	MSP-1602 Motor Winding Temperature Phase B	I-104	RTU-9130	0-200 ºF	
125	UA-7304	LAN	AC-1	HVAC Alarm - Electrical Room	I-107	RTU-9130		
126	TAH-1602C	LAN	PMCS-9110	MSP-1602 Motor Winding Temperature Phase C	I-104	RTU-9130	0-200 ºF	
127	LAHH-7791	LAN	PMCS-9110	High Level/Flooding - Sump Pit 1	I-108	RTU-9130		
128	QS-1602A	LAN	PMCS-9110	MSP-1602 Not in Auto	I-104	RTU-9130		
129	LAHH-7792	LAN	PMCS-9110	High Level/Flooding - Sump Pit 2	I-108	RTU-9130		
130	UAA-1602	LAN	PMCS-9110	MSP-1602 Not in Service	I-104	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
131	LAHH-7793	LAN	PMCS-9110	High Level/Flooding - Sump Pit 3	I-108	RTU-9130		
132	KI-1602S	LAN	PMCS-9110	MSP-1602 Number of Starts	I-104	RTU-9130		
133	LAHH-7794	LAN	PMCS-9110	High Level/Flooding - Sump Pit 4	I-108	RTU-9130		
134	QI-1602	LAN	PMCS-9110	MSP-1602 On-Off	I-104	RTU-9130		
135	LAHH-7795	LAN	PMCS-9110	High Level/Flooding - Sump Pit 5	I-108	RTU-9130		
136	UA-1602A	LAN	PMCS-9110	MSP-1602 RVSS Fail/Motor Overload	I-104	RTU-9130		
137	LAHH-7796	LAN	PMCS-9110	High Level/Flooding - Sump Pit 6	I-108	RTU-9130		
138	KI-1602R	LAN	PMCS-9110	MSP-1602 Total Run Time	I-104	RTU-9130	Σ hours	
139	LAHH-7797	LAN	PMCS-9110	High Level/Flooding - Sump Pit 7	I-108	RTU-9130		
140	LAHH-7798	LAN	PMCS-9110	High Level/Flooding – Sump Pit 8	I-108			
141	VAH-1602X	LAN	PMCS-9110	MSP-1602 Vibration X-Axis	I-104	RTU-9130		
142	PAL-7902	LAN	PMCS-9110	Service Air Low Pressure	I-108	RTU-9130		
143	XA-9110R	LAN	PMCS-9110	PMCS 24VDC RPS Fault	I-101	RTU-9130		
144	VAH-1602Y	LAN	PMCS-9110	MSP-1602 Vibration Y-Axis	I-104	RTU-9130		
145	XA-9110U	LAN	PMCS-9110	PMCS UPS Fault	I-101	RTU-9130		
146	XA-1600U	LAN	MSPCP-1600	MSPCP UPS Fault	I-101	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
146	VAH-1602Z	LAN	PMCS-9110	MSP-1602 Vibration Z-Axis	I-104	RTU-9130		
147	XA-1600U	LAN	MSPCP-1600	MSPCP UPS Fault	I-101	RTU-9130		
148	XA-1602D	LAN	PMCS-9110	MSP-1602 Water in Oil	I-104	RTU-9130		
149	XA-1600R	LAN	MSPCP-1600	MSPCP 24VDC RPS Fault	I-101	RTU-9130		
150	AI-1603	LAN	PMCS-9110	MSP-1603 Available	I-104	RTU-9130		
151	ZIC-1603	LAN	PMCS-9110	MSP-1603 Check Valve Closed	I-104	RTU-9130		
152	ZAC-1603	LAN	PMCS-9110	MSP-1603 Check Valve Not Fully Closed	I-104	RTU-9130		
153	ZAO-1603	LAN	PMCS-9110	MSP-1603 Check Valve Not Fully Open	I-104	RTU-9130		
154	ZIO-1603	LAN	PMCS-9110	MSP-1603 Check Valve Open	I-104	RTU-9130		
155	ECI-1603	LAN	PMCS-9110	MSP-1603 Control Voltage	I-104	RTU-9130	0-150 V	
156	ECA-1603	LAN	PMCS-9110	MSP-1603 Control Voltage Fail	I-104	RTU-9130		
157	PIR-1603	LAN	PMCS-9110	MSP-1603 Discharge Pressure	I-104	RTU-9130	0-100 psi	
158	UA-1603B	LAN	PMCS-9110	MSP-1603 Fault	I-104	RTU-9130		
159	IA-1603	LAN	PMCS-9110	MSP-1603 Motor Current Imbalance	I-104	RTU-9130		
160	II-1603A	LAN	PMCS-9110	MSP-1603 Motor Current Phase A	I-104	RTU-9130	0-150 A	
161	II-1603B	LAN	PMCS-9110	MSP-1603 Motor Current Phase B	I-104	RTU-9130	0-150 A	
162	II-1603C	LAN	PMCS-9110	MSP-1603 Motor Current Phase C	I-104	RTU-9130	0-150 A	
163	JKI-1603	LAN	PMCS-9110	MSP-1603 Motor Energy	I-104	RTU-9130	Σ kWh	
164	TAH-1603D	LAN	PMCS-9110	MSP-1603 Motor Main Bearing Temperature	I-104	RTU-9130	0-200 ºF	
165	JI-1603	LAN	PMCS-9110	MSP-1603 Motor Power	I-104	RTU-9130	0-100 kW	
166	JU-1603	LAN	PMCS-9110	MSP-1603 Motor Power Factor	I-104	RTU-9130	0-100%	
167	XA-1603A	LAN	PMCS-9110	MSP-1603 Motor Stator Housing Leak	I-104	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
168	TAH-1603E	LAN	PMCS-9110	MSP-1603 Motor Support Bearing Temperature	I-104	RTU-9130	0-200 ºF	
169	EA-1603	LAN	PMCS-9110	MSP-1603 Motor Voltage Imbalance	I-104	RTU-9130		
170	EI-1603A	LAN	PMCS-9110	MSP-1603 Motor Voltage Phase A	I-104	RTU-9130	0-600 V	
171	EI-1603B	LAN	PMCS-9110	MSP-1603 Motor Voltage Phase B	I-104	RTU-9130	0-600 V	
172	EI-1603C	LAN	PMCS-9110	MSP-1603 Motor Voltage Phase C	I-104	RTU-9130	0-600 V	
173	TAH-1603A	LAN	PMCS-9110	MSP-1603 Motor Winding Temperature Phase A	I-104	RTU-9130	0-200 ºF	
174	TAH-1603B	LAN	PMCS-9110	MSP-1603 Motor Winding Temperature Phase B	I-104	RTU-9130	0-200 ºF	
175	TAH-1603C	LAN	PMCS-9110	MSP-1603 Motor Winding Temperature Phase C	I-104	RTU-9130	0-200 ºF	
176	QS-1603A	LAN	PMCS-9110	MSP-1603 Not in Auto	I-104	RTU-9130		
177	UAA-1603	LAN	PMCS-9110	MSP-1603 Not in Service	I-104	RTU-9130		
178	KI-1603S	LAN	PMCS-9110	MSP-1603 Number of Starts	I-104	RTU-9130		
179	QI-1603	LAN	PMCS-9110	MSP-1603 On-Off	I-104	RTU-9130		
180	UA-1603A	LAN	PMCS-9110	MSP-1603 RVSS Fail/Motor Overload	I-104	RTU-9130		
181	KI-1603R	LAN	PMCS-9110	MSP-1603 Total Run Time	I-104	RTU-9130	Σ hours	
182	VAH-1603X	LAN	PMCS-9110	MSP-1603 Vibration X-Axis	I-104	RTU-9130		
183	VAH-160Y	LAN	PMCS-9110	MSP-1603 Vibration Y-Axis	I-104	RTU-9130		
184	VAH-1603Z	LAN	PMCS-9110	MSP-1603 Vibration Z-Axis	I-104	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
185	XA-1603B	LAN	PMCS-9110	MSP-1603 Water in Oil	I-104	RTU-9130		
186	AI-1604	LAN	PMCS-9110	MSP-1604 Available	I-105	RTU-9130		
187	ZIC-1604	LAN	PMCS-9110	MSP-1604 Check Valve Closed	I-105	RTU-9130		
188	ZAC-1604	LAN	PMCS-9110	MSP-1604 Check Valve Not Fully Closed	I-105	RTU-9130		
189	ZAO-1604	LAN	PMCS-9110	MSP-1604 Check Valve Not Fully Open	I-105	RTU-9130		
190	ZIO-1604	LAN	PMCS-9110	MSP-1604 Check Valve Open	I-105	RTU-9130		
191	ECI-1604	LAN	PMCS-9110	MSP-1604 Control Voltage	I-105	RTU-9130	0-150 V	
192	ECA-1604	LAN	PMCS-9110	MSP-1604 Control Voltage Fail	I-105	RTU-9130		
193	PIR-1604	LAN	PMCS-9110	MSP-1604 Discharge Pressure	I-105	RTU-9130	0-100 psi	
194	UA-1604B	LAN	PMCS-9110	MSP-1604 Fault	I-105	RTU-9130		
195	IA-1604	LAN	PMCS-9110	MSP-1604 Motor Current Imbalance	I-105	RTU-9130		
196	II-1604A	LAN	PMCS-9110	MSP-1604 Motor Current Phase A	I-105	RTU-9130	0-150 A	
197	II-1604B	LAN	PMCS-9110	MSP-1604 Motor Current Phase B	I-105	RTU-9130	0-150 A	
198	II-1604C	LAN	PMCS-9110	MSP-1604 Motor Current Phase C	I-105	RTU-9130	0-150 A	
199	JKI-1604	LAN	PMCS-9110	MSP-1604 Motor Energy	I-105	RTU-9130	Σ kWh	
200	TAH-1604D	LAN	PMCS-9110	MSP-1604 Motor Main Bearing Temperature	I-105	RTU-9130	0-200 ºF	
201	JI-1604	LAN	PMCS-9110	MSP-1604 Motor Power	I-105	RTU-9130	0-100 kW	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
202	JU-1604	LAN	PMCS-9110	MSP-1604 Motor Power Factor	I-105	RTU-9130	0-100%	
203	XA-1604A	LAN	PMCS-9110	MSP-1604 Motor Stator Housing Leak	I-105	RTU-9130		
204	TAH-1604E	LAN	PMCS-9110	MSP-1604 Motor Support Bearing Temperature	I-105	RTU-9130	0-200 ºF	
205	EA-1604	LAN	PMCS-9110	MSP-1604 Motor Voltage Imbalance	I-105	RTU-9130		
206	EI-1604A	LAN	PMCS-9110	MSP-1604 Motor Voltage Phase A	I-105	RTU-9130	0-600 V	
207	EI-1604B	LAN	PMCS-9110	MSP-1604 Motor Voltage Phase B	I-105	RTU-9130	0-600 V	
208	EI-1604C	LAN	PMCS-9110	MSP-1604 Motor Voltage Phase C	I-105	RTU-9130	0-600 V	
209	TAH-1604A	LAN	PMCS-9110	MSP-1604 Motor Winding Temperature Phase A	I-105	RTU-9130	0-200 ºF	
210	TAH-1604B	LAN	PMCS-9110	MSP-1604 Motor Winding Temperature Phase B	I-105	RTU-9130	0-200 ºF	
211	TAH-1604C	LAN	PMCS-9110	MSP-1604 Motor Winding Temperature Phase C	I-105	RTU-9130	0-200 ºF	
212	QS-1604A	LAN	PMCS-9110	MSP-1604 Not in Auto	I-105	RTU-9130		
213	UAA-1604	LAN	PMCS-9110	MSP-1604 Not in Service	I-105	RTU-9130		
214	KI-1604S	LAN	PMCS-9110	MSP-1604 Number of Starts	I-105	RTU-9130		
215	QI-1604	LAN	PMCS-9110	MSP-1604 On-Off	I-105	RTU-9130		
216	UA-1604A	LAN	PMCS-9110	MSP-1604 RVSS Fail/Motor Overload	I-105	RTU-9130		
217	KI-1604R	LAN	PMCS-9110	MSP-1604 Total Run Time	I-105	RTU-9130	Σ hours	
218	VAH-1604X	LAN	PMCS-9110	MSP-1604 Vibration X-Axis	I-105	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
219	VAH-1604Y	LAN	PMCS-9110	MSP-1604 Vibration Y-Axis	I-105	RTU-9130		
220	VAH-1604Z	LAN	PMCS-9110	MSP-1604 Vibration Z-Axis	I-105	RTU-9130		
221	XA-1604B	LAN	PMCS-9110	MSP-1604 Water in Oil	I-105	RTU-9130		
222	AI-1605	LAN	PMCS-9110	MSP-1605 Available	I-105	RTU-9130		
223	ZIC-1605	LAN	PMCS-9110	MSP-1605 Check Valve Closed	I-105	RTU-9130		
224	ZAC-1605	LAN	PMCS-9110	MSP-1605 Check Valve Not Fully Closed	I-105	RTU-9130		
225	ZAO-1605	LAN	PMCS-9110	MSP-1605 Check Valve Not Fully Open	I-105	RTU-9130		
226	ZIO-1605	LAN	PMCS-9110	MSP-1605 Check Valve Open	I-105	RTU-9130		
227	ECI-1605	LAN	PMCS-9110	MSP-1605 Control Voltage	I-105	RTU-9130	0-150 V	
228	ECA-1605	LAN	PMCS-9110	MSP-1605 Control Voltage Fail	I-105	RTU-9130		
229	PIR-1605	LAN	PMCS-9110	MSP-1605 Discharge Pressure	I-105	RTU-9130	0-100 psi	
230	UA-1605B	LAN	PMCS-9110	MSP-1605 Fault	I-105	RTU-9130		
231	IA-1605A	LAN	PMCS-9110	MSP-1605 Motor Current Imbalance	I-105	RTU-9130		
232	II-1605AA	LAN	PMCS-9110	MSP-1605 Motor Current Phase A	I-105	RTU-9130	0-150 A	
233	II-1605AB	LAN	PMCS-9110	MSP-1605 Motor Current Phase B	I-105	RTU-9130	0-150 A	
234	II-1605AC	LAN	PMCS-9110	MSP-1605 Motor Current Phase C	I-105	RTU-9130	0-150 A	
235	JKI-1605A	LAN	PMCS-9110	MSP-1605 Motor Energy	I-105	RTU-9130	Σ kWh	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
236	TAH-1605E	LAN	PMCS-9110	MSP-1605 Motor Main Bearing Temperature	I-105	RTU-9130	0-200 ºF	
237	JI-1605A	LAN	PMCS-9110	MSP-1605 Motor Power	I-105	RTU-9130	0-100 kW	
238	JU-1605A	LAN	PMCS-9110	MSP-1605 Motor Power Factor	I-105	RTU-9130	0-100%	
239	XA-1605A	LAN	PMCS-9110	MSP-1605 Motor Stator Housing Leak	I-105	RTU-9130		
240	TAH-1605E	LAN	PMCS-9110	MSP-1605 Motor Support Bearing Temperature	I-105	RTU-9130	0-200 ºF	
241	EI-1605A	LAN	PMCS-9110	MSP-1605 Motor Voltage Phase A	I-105	RTU-9130	0-600 V	
242	EI-1605B	LAN	PMCS-9110	MSP-1605 Motor Voltage Phase B	I-105	RTU-9130	0-600 V	
243	EI-1605C	LAN	PMCS-9110	MSP-1605 Motor Voltage Phase C	I-105	RTU-9130	0-600 V	
244	TAH-1605A	LAN	PMCS-9110	MSP-1605 Motor Winding Temperature Phase A	I-105	RTU-9130	0-200 ºF	
245	TAH-1605B	LAN	PMCS-9110	MSP-1605 Motor Winding Temperature Phase B	I-105	RTU-9130	0-200 ºF	
246	TAH-1605C	LAN	PMCS-9110	MSP-1605 Motor Winding Temperature Phase C	I-105	RTU-9130	0-200 ºF	
247	QS-1605A	LAN	PMCS-9110	MSP-1605 Not in Auto	I-105	RTU-9130		
248	UAA-1605	LAN	PMCS-9110	MSP-1605 Not in Service	I-105	RTU-9130		
249	KI-1605S	LAN	PMCS-9110	MSP-1605 Number of Starts	I-105	RTU-9130		
250	QI-1605	LAN	PMCS-9110	MSP-1605 On-Off	I-105	RTU-9130		
251	UA-1605A	LAN	PMCS-9110	MSP-1605 RVSS Fail/Motor Overload	I-105	RTU-9130		
252	KI-1605R	LAN	PMCS-9110	MSP-1605 Total Run Time	I-105	RTU-9130	Σ hours	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
253	VAH-1605X	LAN	PMCS-9110	MSP-1605 Vibration X-Axis	I-105	RTU-9130		
254	VAH-1605Y	LAN	PMCS-9110	MSP-1605 Vibration Y-Axis	I-105	RTU-9130		
255	VAH-1605Z	LAN	PMCS-9110	MSP-1605 Vibration Z-Axis	I-105	RTU-9130		
256	XA-1605B	LAN	PMCS-9110	MSP-1605 Water in Oil	I-105	RTU-9130		
257	AI-1606A	LAN	PMCS-9110	MSP-1606 Available	I-105	RTU-9130		
258	ZIC-1606A	LAN	PMCS-9110	MSP-1606 Check Valve Closed	I-105	RTU-9130		
259	ZAC-1606A	LAN	PMCS-9110	MSP-1606 Check Valve Not Fully Closed	I-105	RTU-9130		
260	ZAO-1606A	LAN	PMCS-9110	MSP-1606 Check Valve Not Fully Open	I-105	RTU-9130		
261	ZIO-1606A	LAN	PMCS-9110	MSP-1606 Check Valve Open	I-105	RTU-9130		
262	ECI-1606A	LAN	PMCS-9110	MSP-1606 Control Voltage	I-105	RTU-9130	0-150 V	
263	ECA-1606A	LAN	PMCS-9110	MSP-1606 Control Voltage Fail	I-105	RTU-9130		
264	PIR-1606	LAN	PMCS-9110	MSP-1606 Discharge Pressure	I-105	RTU-9130	0-100 psi	
265	XA-1606K	LAN	PMCS-9110	MSP-1606 Discharge Valve Fail	I-105	RTU-9130		
266	UA-1606B	LAN	PMCS-9110	MSP-1606 Fault	I-105	RTU-9130		
267	IA-1606	LAN	PMCS-9110	MSP-1606 Motor Current Imbalance	I-105	RTU-9130		
268	II-1606A	LAN	PMCS-9110	MSP-1606 Motor Current Phase A	I-105	RTU-9130	0-150 A	
269	II-1606B	LAN	PMCS-9110	MSP-1606 Motor Current Phase B	I-105	RTU-9130	0-150 A	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
270	II-1606C	LAN	PMCS-9110	MSP-1606 Motor Current Phase C	I-105	RTU-9130	0-150 A	
271	JKI-1606	LAN	PMCS-9110	MSP-1606 Motor Energy	I-105	RTU-9130	Σ kWh	
272	TAH-1606D	LAN	PMCS-9110	MSP-1606 Motor Main Bearing Temperature	I-105	RTU-9130	0-200 ºF	
273	JI-1606	LAN	PMCS-9110	MSP-1606 Motor Power	I-105	RTU-9130	0-100 kW	
274	JU-1606	LAN	PMCS-9110	MSP-1606 Motor Power Factor	I-105	RTU-9130	0-100%	
275	XA-1606A	LAN	PMCS-9110	MSP-1606 Motor Stator Housing Leak	I-105	RTU-9130		
276	TAH-1606E	LAN	PMCS-9110	MSP-1606 Motor Support Bearing Temperature	I-105	RTU-9130	0-200 ºF	
277	EA-1606	LAN	PMCS-9110	MSP-1606 Motor Voltage Imbalance	I-105	RTU-9130		
278	EI-1606A	LAN	PMCS-9110	MSP-1606 Motor Voltage Phase A	I-105	RTU-9130	0-600 V	
279	LAH-027	LAN	PMCS-9110	Wet Well Level High Primary	I-103	RTU-9130		
280	EI-1606B	LAN	PMCS-9110	MSP-1606 Motor Voltage Phase B	I-105	RTU-9130	0-600 V	
281	LAH-028	LAN	PMCS-9110	Wet Well Level High Secondary	I-103	RTU-9130		
282	EI-1606C	LAN	PMCS-9110	MSP-1606 Motor Voltage Phase C	I-105	RTU-9130	0-600 V	
283	LAHH-027	LAN	PMCS-9110	Wet Well Level High-High Primary	I-103	RTU-9130		
284	TAH-1606A	LAN	PMCS-9110	MSP-1606 Motor Winding Temperature Phase A	I-105	RTU-9130	0-200 ºF	
285	LAHH-028	LAN	PMCS-9110	Wet Well Level High-High Secondary	I-103	RTU-9130		
286	TAH-1606B	LAN	PMCS-9110	MSP-1606 Motor Winding Temperature Phase B	I-105	RTU-9130	0-200 ºF	

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
287	LAL-027	LAN	PMCS-9110	Wet Well Level Low Primary	I-103	RTU-9130		
288	TAH-1606C	LAN	PMCS-9110	MSP-1606 Motor Winding Temperature Phase C	I-105	RTU-9130	0-200 ºF	
289	LAL-028	LAN	PMCS-9110	Wet Well Level Low Secondary	I-103	RTU-9130		
290	QS-1606A	LAN	PMCS-9110	MSP-1606 Not in Auto	I-105	RTU-9130		
291	LALL-027	LAN	PMCS-9110	Wet Well Level Low-Low Primary	I-103	RTU-9130		
292	UAA-1606	LAN	PMCS-9110	MSP-1606 Not in Service	I-105	RTU-9130		
293	LALL-028	LAN	PMCS-9110	Wet Well Level Low-Low Secondary	I-103	PMCS-9110		
294	KI-1606S	LAN	PMCS-9110	MSP-1606 Number of Starts	I-105	RTU-9130		
295	LIR-027	LAN	MSPCP-1600	Wet Well Level Primary	I-103	PMCS-9110	0-14 feet	
296	QI-1606	LAN	PMCS-9110	MSP-1606 On-Off	I-105	RTU-9130		
297	LIR-028	LAN	MSPCP-1600	Wet Well Level Secondary	I-103	PMCS-9110	0-14 feet	
298	UA-1606A	LAN	PMCS-9110	MSP-1606 RVSS Fail/Motor Overload	I-105	RTU-9130		
299	KI-1606R	LAN	PMCS-9110	MSP-1606 Total Run Time	I-105	RTU-9130	Σ hours	
300	VAH-1606X	LAN	PMCS-9110	MSP-1606 Vibration X-Axis	I-105	RTU-9130		
301	VAH-1606Y	LAN	PMCS-9110	MSP-1606 Vibration Y-Axis	I-105	RTU-9130		
302	VAH-1606Z	LAN	PMCS-9110	MSP-1606 Vibration Z-Axis	I-105	RTU-9130		
303	XA-1606B	LAN	PMCS-9110	MSP-1606 Water in Oil	I-105	RTU-9130		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
304	LIR-026	LAN	LT-026	Ralph Avenue Inlet Bypass Chamber Flow (Level)	I-103	PMCS-9110	0-14 feet	
305	LAH-026	LAN	PMCS-9110	Ralph Avenue Sewer Level High Alarm	I-103	RTU-9130		
306	52-1N-P	DI	EMCS-1510	SERVICE NO. 1, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
307	52-1N-P	DI	EMCS-1510	SERVICE NO. 1, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
308	52-1N-S	DI	EMCS-1510	SERVICE NO. 1, SECONDARY MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
309	52-1N-S	DI	EMCS-1510	SERVICE NO. 1, SECONDARY MAIN BREAKER TRIPPED	I-101	PMCS-9110		
310	52-2N	DI	EMCS-1510	SERVICE NO. 2, MAIN BREAKER OPENED/CLOSED	I-101	PMCS-9110		
311	52-2N	DI	EMCS-1510	SERVICE NO. 2, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
312	ATS-1A	DI	EMCS-1510	ATS-1A NORMAL SIDE	I-101	PMCS-9110		
313	ATS-1A	DI	EMCS-1510	ATS-1A EMERGENCY SIDE	I-101	PMCS-9110		
314	ATS-1B	DI	EMCS-1510	ATS-1B NORMAL SIDE	I-101	PMCS-9110		
315	ATS-1B	DI	EMCS-1510	ATS-1B EMERGENCY SIDE	I-101	PMCS-9110		
316	PM-1	LAN	EMCS-1510	MCC-1A POWER MONITOR SERVICE NO. 1 - V, A, kW, kVAR, kVA, PF, THD	I-101	PMCS-9110		
317	52-1A	DI	EMCS-1510	MCC-1A, MAIN BREAKER MCC BUS A, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
318	52-1A	DI	EMCS-1510	MCC-1A, MAIN BREAKER MCC BUS A, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
319	52-TA	DI	EMCS-1510	MCC-1A, TIE BREAKER OPEN/CLOSED	I-101	PMCS-9110		
320	52-TA	DI	EMCS-1510	MCC-1A, TIE BREAKER TRIPPED	I-101	PMCS-9110		
321	52-TB	DI	EMCS-1510	MCC-1B, TIE BREAKER OPEN/CLOSED	I-101	PMCS-9110		
322	52-TB	DI	EMCS-1510	MCC-1B, TIE BREAKER TRIPPED	I-101	PMCS-9110		
323	PM-2	LAN	EMCS-1510	MCC-1B, POWER MONITOR SERVICE NO. 2 - V, A, kW, kVAR, kVA, PF, THD	I-101	PMCS-9110		
324	52-1B	DI	EMCS-1510	MCC-1B, MAIN BREAKER OPEN/CLOSED	I-101	PMCS-9110		
325	52-1B	DI	EMCS-1510	MCC-1B, MAIN BREAKER TRIPPED	I-101	PMCS-9110		
326	52-1E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, STANDBY GENERATOR BREAKER OPENED/CLOSED	I-101	PMCS-9110		
327	52-1E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, STANDBY GENERATOR BREAKER TRIPPED	I-101	PMCS-9110		
328	52-2E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, PORTABLE GENERATOR BREAKER OPENED/CLOSED	I-101	PMCS-9110		

Table 3 - Input/Output List - RTU-9130

Item No.	Tag No.	I/O Type	Instrument Type	Service	P&ID No.	Location	Range	Remarks
329	52-2E	DI	EMCS-1510	GENERATOR SWITCHBOARD BREAKER, PORTABLE GENERATOR BREAKER TRIPPED	I-101	PMCS-9110		
330	QI-8511	LAN	GMCP-8510	GENERATOR RUNNING	I-101	PMCS-9110		
331	JI-8512	LAN	GMCP-8510	GENERATOR POWER METERING - V, A, kW, kVA, PF, F	I-101	PMCS-9110		
332	UC-8513	LAN	GMCP-8510	GENERATOR START/STOP	I-101	PMCS-9110		
333	UC-8514	LAN	GMCP-8510	GENERATOR EMERGENCY STOP	I-101	PMCS-9110		
334	XAH-8515	LAN	GMCP-8510	GENERATOR OVERCRANK SHUTDOWN	I-101	PMCS-9110		
335	TAH-8516	LAN	GMCP-8510	GENERATOR HIGH ENGINE TEMP SHUTDOWN	I-101	PMCS-9110		
336	PAL-8517	LAN	GMCP-8510	GENERATOR LOW LUBE OIL PRES SHUTDOWN	I-101	PMCS-9110		
337	SAH-8518	LAN	GMCP-8510	GENERATOR OVERSPEED SHUTDOWN	I-101	PMCS-9110		
338	XAH-8519	LAN	GMCP-8510	GENERATOR OVERCRANK WARNING	I-101	PMCS-9110		
339	TAH-8520	LAN	GMCP-8510	GENERATOR HIGH ENGINE TEMP WARNING	I-101	PMCS-9110		
340	PAL-8521	LAN	GMCP-8510	GENERATOR LOW LUBE OIL PRES WARNING	I-101	PMCS-9110		
341	SAH-8522	LAN	GMCP-8510	GENERATOR OVERSPEED WARNING	I-101	PMCS-9110		

Table 3 - Input/Output List - RTU-9130

342	LAL-8523	LAN	GMCP-8510	GENERATOR COOLANT LOW LEVEL	I-101	PMCS-9110		
343	EAH-8524	LAN	GMCP-8510	GENERATOR BATTERY HIGH VOLTAGE	I-101	PMCS-9110		
344	EAL-8525	LAN	GMCP-8510	GENERATOR BATTERY LOW CRANKING VOLTAGE	I-101	PMCS-9110		
345	EAL-8526	LAN	GMCP-8510	GENERATOR BATTERY LOW VOLTAGE	I-101	PMCS-9110		
346	EAL-8527	LAN	GMCP-8510	GENERATOR BATTERY CHARGER AC FAILURE	I-101	PMCS-9110	0-14 feet	
347	HC-8528	LAN	GMCP-8510	GENERATOR LAMP TEST	I-101	PMCS-9110		
348		WAN	RTU-9130	All of the above signals	I-101	CCFISS		
349		WAN	RTM-1	Real-Time Metering of Utility Service #1	I-101	DCAS		
350		WAN	RTM-2	Real-Time Metering of Utility Service #2	I-101	DCAS		

PHYSICAL I/O COUNT - RTU-9130			
I/O Type	Used	Spare	Required
AI	0	0	0
AO	0	0	0
DI	30	8	38
DO	0	0	0

SECTION 40 61 94 – PMCS INSTRUMENT INDEX
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section provides a listing of the minimum field and panel Instruments to be provided by the Contractor.

B. Additional Instruments may be required based on the actual equipment provided by the Contractor, and these additional Instruments shall be provided at no additional cost to DEP.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Application	5
3.03	Field Testing / Quality Control	5
3.04	Startup / Demonstration	5
3.05	Adjusting / Protection / Cleanup	5

D. The Instrument Index is provided in Table 1, attached after the End of Section designation.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 61 93 – PMCS Input Output List

C. Section 40 67 16 – PMCS Panels and Enclosures

D. Section 40 79 91 – PMCS Field Instruments

1.04 REFERENCES

A. Definitions

1. I/O – Input/Output
2. SFT – Start-up and Field Testing.
3. OAD – Operational Availability Demonstration.
4. URT – Upset and Recovery Testing.
5. WFAT - Witnessed Factory Acceptance Tests.
6. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. Field and Panel Instruments:

1. As a minimum, the Contractor shall furnish and install all field and panel instruments indicated in the accompanying Instrument Index.
2. The Contractor shall review the P&IDs, Mechanical and Electrical drawings and individual equipment specifications for additional requirements.
3. Individual control and indicating devices such as selector switches, pushbuttons and indicating lights are not included in the Instrument Index and must be accounted for from the drawings, control sequence descriptions and individual equipment specifications.
4. The listing includes information on signal functions, signal ranges and range conversions and set points.
5. As a minimum, the Contractor shall provide all hardware [and software] to provide the Instruments in the accompanying Index as indicated in the Contract Documents and as required.

B. Instrument Index Column Headings

1. NO or Ref NO or Item NO – is a sequential number starting with a discrete number used to order the entries in the Index and permitting the Index to sorted and resorted to its original order.

2. TAG NUMBER – is an alpha numeric character string used to identify the instrument function and is defined in Section 40 61 93 – PMCS Input Output List.

3. INSTRUMENT TYPE – is an alphanumeric string up 30 positions describing the kind of Instrument such as:

   a. Float Assembly

   b. Pressure Gauge

   c. Level Transmitter

   d. Chart Recorder

   e. pH Sensor

4. SERVICE – is an alphanumeric string up 30 positions describing the process function the Instrument is used for.

5. LOCATION – is the listing of the physical location of the instrument.

6. P&ID NUMBR – is the listing of the P&ID Drawing where the Instrument can be found.

7. RANGE – is the monitoring range of the Instrument in engineering units.

8. SET POINT – is the setting in engineering units at which Instrument will initiate an action in the PMCS or equipment control or just provide an alarm indication.

9. REMARKS – can be used for supplementary information or to cross-reference information.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section, and the Contract Documents.

B. For each Instrument listed in the Instrument Index which cannot be used exactly as listed, submit an explanation of the reason for the deviation and propose a method to modify the Instrument Index information.

C. Information specific to all Instruments shall in addition be submitted with the submittal covering that Instrument.

D. Instrumentation Index shall be kept current, updated regularly and shall be available for inspection by the City at the Project Site.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit Instrument Index and schedules for the approval of the Engineer.

C. The Contractor is solely responsible for the timing of Instrument Index submittals to enable approval by the Engineer and subsequent use by the PMCS Supplier.

D. The Contractor shall create, maintain and submit for review, an updated Instrument Index of all instruments.

E. Submittal shall be made at least [60] [90] days in advance of any proposed use by the PMCS Supplier.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS Instrument Index shall be implemented by the PMCS Supplier.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS Factory Test shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. Section 40 80 81 - PMCS Factory Tests details how the Instruments specified under this Section shall be verified against approved submittals.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 APPLICATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. PMCS Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. Section 40 80 82 - PMCS Startup and Field Testing details how the Instruments specified under this Section shall be verified during Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the correct functioning of all Instruments.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

[Attached: Table 1 – Instrument Index]

TABLE 1 – INSTRUMENT INDEX

Item No.	Tag No.	Instrument Type	Service	P&ID No.	Location	Range	Setpoint	Remarks
1	LE/LIT-026	Level Transducer	Continuous level measurement	I-103	Ralph Avenue Inlet Bypass Chamber	0 – 170 inches	level at 50 mgd	
2	LE/LIT-027	Level Transducer	Continuous level measurement	I-103	Wet Well	0 – 170 inches	level at 50 mgd	
3	LE/LIT-028	Level Transmitter	Continuous level measurement	I-103	Wet Well	0 – 170 inches	level at 50 mgd	
4	LSLL-030	Float Switch	Backup low-low level alarm	I-103	Wet Well	NA	-14.00 feet	
5	LSL-030	Float Switch	Backup level control	I-103	Wet Well	NA	-13.00 feet	
6	LS-030A	Float Switch	Backup level control	I-103	Wet Well	NA	-11.00 feet	
7	LS-030B	Float Switch	Backup level control	I-103	Wet Well	NA	-10.50 feet	
8	LS-030C	Float Switch	Backup level control	I-103	Wet Well	NA	-10.00 feet	
9	LS-030D	Float Switch	Backup level control	I-103	Wet Well	NA	-9.50 feet	
10	LS-030E	Float Switch	Backup level control	I-103	Wet Well	NA	-9.00 feet	
11	LS-030F	Float Switch	Backup level control	I-103	Wet Well	NA	-8.50 feet	
12	LSH-030	Float Switch	Backup high level alarm	I-103	Wet Well	NA	-8.00 feet	

TABLE 1 – INSTRUMENT INDEX

Item No.	Tag No.	Instrument Type	Service	P&ID No.	Location	Range	Setpoint	Remarks
13	LSHH-030	Float Switch	Backup high-high level alarm	I-103	Wet Well	NA	-7.50 feet	
14	AE/AIT-121	Gas Detector	Methane (CH4) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
15	AE/AIT-122	Gas Detector	Methane (CH4) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
16	AE/AIT-131	Gas Detector	Hydrogen Sulfide (H2S) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
17	AE/AIT-132	Gas Detector	Hydrogen Sulfide (H2S) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
18	AE/AIT-141	Gas Detector	Oxygen (O2) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
19	AE/AIT-142	Gas Detector	Oxygen (O2) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
20	AE/AIT-151	Gas Detector	Carbon Monoxide (CO) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
21	AE/AIT-152	Gas Detector	Carbon Monoxide (CO) gas detection	I-103	Wet Well	0 – 100 % LEL	35 & 60 % LEL	
22	PI-1601	Pressure Gauge	MSP-1601 suction pressure measurement	I-104	MSP-1601 suction	0 - 15 psig	NA	
23	PI-1601A	Pressure Gauge	MSP-1601 discharge pressure measurement	I-104	MSP-1601 discharge	0 - 15 psig	NA	
24	PIT-1601	Pressure Transmitter	MSP-1601 discharge pressure measurement	I-104	MSP-1601 discharge	0 - 15 psig	NA	

TABLE 1 – INSTRUMENT INDEX

Item No.	Tag No.	Instrument Type	Service	P&ID No.	Location	Range	Setpoint	Remarks
25	ZSO-1601	Proximity or limit switch	MSP-1601 check valve fully opened position indication	I-104	MSP-1601 check valve	NA	100% Open	
26	PI-1602	Pressure Gauge	MSP-1602 suction pressure measurement	I-104	MSP-1602 suction	0 - 15 psig	NA	
27	PI-1602A	Pressure Gauge	MSP-1602 discharge pressure measurement	I-104	MSP-1602 discharge	0 - 15 psig	NA	
28	PIT-1602	Pressure Transmitter	MSP-1602 discharge pressure measurement	I-104	MSP-1602 discharge	0 - 15 psig	NA	
29	ZSO-1602	Proximity or limit switch	MSP-1602 check valve fully opened position indication	I-104	MSP-1602 check valve	NA	100% Open	
30	PI-1603	Pressure Gauge	MSP-1603 suction pressure measurement	I-104	MSP-1603 suction	0 - 15 psig	NA	
31	PI-1603A	Pressure Gauge	MSP-1603 discharge pressure measurement	I-104	MSP-1603 discharge	0 - 15 psig	NA	
32	PIT-1603	Pressure Transmitter	MSP-1603 discharge pressure measurement	I-104	MSP-1603 discharge	0 - 15 psig	NA	
33	ZSO-1603	Proximity or limit switch	MSP-1603 check valve fully opened position indication	I-104	MSP-1603 check valve	NA	100% Open	
34	PI-1604	Pressure Gauge	MSP-1604 suction pressure measurement	I-105	MSP-1604 suction	0 - 15 psig	NA	
35	PI-1604A	Pressure Gauge	MSP-1604 discharge pressure measurement	I-105	MSP-1604 discharge	0 - 15 psig	NA	
36	PIT-1604	Pressure Transmitter	MSP-1604 discharge pressure measurement	I-105	MSP-1604 discharge	0 - 15 psig	NA	

TABLE 1 – INSTRUMENT INDEX

Item No.	Tag No.	Instrument Type	Service	P&ID No.	Location	Range	Setpoint	Remarks
37	ZSO-1604	Proximity or limit switch	MSP-1604 check valve fully opened position indication	I-105	MSP-1604 check valve	NA	100% Open	
38	PI-1605	Pressure Gauge	MSP-1605 suction pressure measurement	I-105	MSP-1605 suction	0 - 15 psig	NA	
39	PI-1605A	Pressure Gauge	MSP-1605 discharge pressure measurement	I-105	MSP-1605 discharge	0 - 15 psig	NA	
40	PIT-1605	Pressure Transmitter	MSP-1605 discharge pressure measurement	I-105	MSP-1605 discharge	0 - 15 psig	NA	
41	ZSO-1605	Proximity or limit switch	MSP-1605 check valve fully opened position indication	I-105	MSP-1605 check valve	NA	100% Open	
42	PI-1606	Pressure Gauge	MSP-1606 suction pressure measurement	I-105	MSP-1606 suction	0 - 15 psig	NA	
43	PI-1606A	Pressure Gauge	MSP-1606 discharge pressure measurement	I-105	MSP-1606 discharge	0 – 100	NA	
44	PIT-1606	Pressure Transmitter	MSP-1606 discharge pressure measurement	I-105	MSP-1606 discharge	0 – 100	NA	
45	ZSO-1606	Proximity or limit switch	MSP-1606 check valve fully opened position indication	I-105	MSP-1606 check valve	NA	100% Open	
46	ZSC-1606	Proximity or limit switch	MSP-1606 check valve full closed position indication	I-105	MSP-1606 check valve	NA	100% Closed	
47	PIT-1610H	Pressure Transmitter	High Service MSPs discharge header pressure measurement	I-104	MSP-1606 discharge	0 – 100	NA	
48	FIT-1610H	Flow Transmitter	High Service MSPs discharge header flow measurement	I-104	MSP-1603 discharge	0 – 40 mgd	NA	

TABLE 1 – INSTRUMENT INDEX

Item No.	Tag No.	Instrument Type	Service	P&ID No.	Location	Range	Setpoint	Remarks
49	PIT-1610L	Pressure Transmitter	Low Service MSPs discharge header pressure measurement	I-105	MSP-1606 discharge	0 – 100	NA	
50	FIT-1610L	Flow Transmitter	Low Service MSPs discharge header flow measurement	I-105	MSP-1603 discharge	0 - 40 mgd	NA	
51	FIR-1610H	Flow Chart Recorder	High Service MSPs discharge header total flow measurement	I-110	PMCS-9110	0 – 80 mgd	NA	
52	FIR-1610L	Flow Chart Recorder	Low Service MSPs discharge header total flow measurement	I-110	PMCS-9110	0 – 80 mgd	NA	
53	ZSC-1601	Proximity or limit switch	MSP-1601 check valve full closed position indication	I-103	MSP-1601 check valve	NA	100% Closed	
54	ZSC-1602	Proximity or limit switch	MSP-1602 check valve full closed position indication	I-103	MSP-1602 check valve	NA	100% Closed	
55	ZSC-1603	Proximity or limit switch	MSP-1603 check valve full closed position indication	I-103	MSP-1603 check valve	NA	100% Closed	
56	ZSC-1604	Proximity or limit switch	MSP-1604 check valve full closed position indication	I-105	MSP-1604 check valve	NA	100% Closed	
57	ZSC-1605	Proximity or limit switch	MSP-1605 check valve full closed position indication	I-105	MSP-1605 check valve	NA	100% Closed	

SECTION 40 61 95 – PMCS MONITORING AND CONTROL CRITERIA
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide the services of the PMCS, BSCP, EMCS, GMCP, VSS, RTU and MSPCP Suppliers, to develop, load, configure, test, document and place in satisfactory operation all hardware and software associated with the PMCS, BSCP, BSCP, EMCS, GMCP, VSS, RTU and MSPCP and all its ancillary devices, as described herein, as required by other Sections, as indicated on the Contract Drawings and as necessary for the Contractor to provide a properly operating and integrated system.

B. The Contractor shall provide a uniform appearance, seamless integration between all PMCS, BSCP, EMCS, GMCP, VSS, RTU and MSPCP equipment and simplification of operation and maintenance, for the software being used and developed for all operator interfaces throughout the Contract.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Application	5
3.03	Field Testing / Quality Control	17
3.04	Startup / Demonstration	17
3.05	Adjusting / Protection / Cleanup	18

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 67 16 – PMCS Panels and Enclosures

C. Section 40 79 91 – PMCS Field Instruments

D. Section 43 23 31.05 – Vertical Centrifugal Pumping Units

1.04 REFERENCES

A. Definitions

1. HMI – Human Machine Interface

2. I/O – Input/Output

3. SFT – Start-up and Field Testing.

4. OAD – Operational Availability Demonstration.

5. OIT – Operator Interface Terminal.

6. URT – Upset and Recovery Testing.

7. WFAT - Witnessed Factory Acceptance Tests.

8. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. PMCS Software Required

1. The software packages the Contractor will be required to [furnish], install, customize, configure, and develop shall include, but shall not be limited to:

a. Workstation(s) and OIT Operating Systems.

b. Workstation(s), and OIT Networking Software.

c. Workstation(s), and OIT Data Management Applications (Spreadsheets, Databases, Word Processing, etc.).

d. Workstation(s), and OIT Utility Programs (Virus scan, remote communication, etc.).

e. PLC and Controller Ladder Logic Development and Documentation Software.

f. PLC and Controller Ladder Logic Application Software.

g. PLC and Controller Specialty Software and Programming Languages.

h. PLC and Controller Configuration Software.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. The PMCS Supplier shall utilize System and Software engineers who have been factory trained and certified on the respective software packages, to perform all programming functions, develop control strategies, create graphic displays, customize applications, document all work and coordinate the software interface.

C. System and Software engineers shall be intimately familiar with the details of this [Plant], instrumentation and control in general and the Contract goals and requirements.

D. System and Software engineers shall have a minimum of 10 years' experience in the PMCS development work required under this Contract.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. The PMCS Supplier shall submit, through the Contractor, the following information for approval prior to beginning of the actual work of developing software for this Contract:

1. Qualifications and certifications of system software engineers.

2. A listing of all proposed software packages indicating quantities and where they will be installed.

3. Preliminary ladder logic for all controllers, PLCs and general methods of implementing the various control strategies.

4. Preliminary database and I/O listing showing system tag names and references.

5. Preliminary screen display count with general system structure.

6. Preliminary screen display development, general display organization and common components.

C. The PMCS Supplier shall submit all completed items to the Engineer for review and approval. As a minimum, the items to be submitted shall include, but shall not be limited to:

1. PLC and Controller ladder logic with full documentation and annotation

2. Full Color copies of all unique Graphic display screens

3. Screen animation and control

4. Databases

5. Alarm and event log lists, formats and messages

D. Submittals shall be made at least 60 days in advance of any proposed use by the PMCS Supplier.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

B. Not Used

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS Monitoring and Control Criteria shall be implemented by the PMCS Supplier.

B. HMI and OIT visualization software shall be as manufactured by:

1. Wonderware, Lake Forest, CA;

2. Or approved equal.

C. PMCS software shall be as manufactured by:

1. Wonderware, Lake Forest, CA;

2. No substitution allowed.

D. Antivirus software shall be as manufactured by:

1. McAfee, San Jose, CA;

2. No substitution allowed.

E. Networking products and software shall be as manufactured by:

1. Cisco Systems, Inc., San Jose, CA;

2. No substitution allowed.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS Factory Testing shall confirm to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. PMCS Monitoring and Control Criteria specified under this Section shall be functionally verified during PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 APPLICATION

A. PMCS Software

1. A single software package that has been approved by the City shall be used for all workstations, HMIs and OITs in this Contract.

2. The Contractor shall furnish to the City, the appropriate number and type of software packages as required by the scope of this Contract.

3. Once installed and operating and the Contract completed and accepted, all licenses, media, documentation and packaging shall be turned over to the City.

4. It shall be the responsibility of the Contractor to maintain all items entrusted to him in excellent condition.

5. Any damaged items or items not returned, shall be replaced at the Contractor's expense.

6. For City furnished PMCS Software required by this Section, it shall be the responsibility of the PMCS Supplier to provide factory training for his personnel, to allow them to become intimately familiar with all aspects of the supplied software package. This cost shall be included in the bid price and shall be done at no additional cost to DEP.

7. It shall also be the responsibility of the Contractor, through the services of the PMCS supplier to install, setup, configure and place in optimum working order all PMCS Software as well as all other software referenced in this Section and as required.

8. All software shall be installed and configured, with strict adherence to manufacturer’s recommendations and the requirements of this Section, on all workstations supplied under this Contract.

B. General Control Philosophy

1. In order for the Contractor to provide the most reliable and fault tolerant PMCS, the following approach to programming shall be implemented:

   a. All control logic, loop control, critical alarming and I/O shall be done in the controller at the local level.

   b. Local workstations and OITs shall contain the database for their attached controllers.

   c. Remote controllers shall access needed data from the respective local controller via the PMCS network shown in the Contract Drawings.

   d. Where the PMCS network is an Ethernet LAN the Contractor shall obtain designated non-routable IP addresses for this contract from DEP OIT.

   e. Workstations and OITs shall send only valid data to the controller and PLC where it shall be "latched in" until such time as new valid data is made available.

   f. A failure of the workstation shall not prevent the controller and PLC from continuing to function normally using the last valid data it received.

   g. All workstations, OITs, controllers and network components, shall be monitored for failures by the redundancy of components and through the use of "watchdog timers" programmed into the software.

   h. Failure of any component shall be alarmed and annunciated at the next level of control and the information shall be immediately made available on the network.

   i. Workstations and OITs shall monitor and display all digital and analog data available on their local controllers and PLCs and all pertinent data available on the network.

   j. Where possible, the software shall be configured to verify the validity of that data.

   k. Data that disagrees or out of valid range shall be indicated as such through the extensive use of displays and alarms.

C. PLC and Controller Programming Conventions

1. General

   a. All logic, sequencing, interlocking, safety and critical alarm and control, shall be implemented at the PLC and/or Controller, as shown on the P&IDs at local level in the respective PLC and Controller using ladder type logic.

      1) Individual "rungs" shall be provided for each logic function.

2) Subroutines shall be used where repetitive logic is required.

3) Alarm logic shall not be performed in subroutines as they may not be active at all times.

b. Commands such as start, stop, open, close, operating mode, sequence selection, etc., that are sent from the remote workstation by operator initiative or response, shall be "pulsed" and "latched" into the controller and PLC logic.

c. All analog loop control such as temperature, flow or level shall be performed at the local controller and PLC level not in the workstation.

d. All calculations and logic necessary to keep an individual loop in operation, in the event of failure of, or loss of communication with the workstation, shall also be done in the local controller and PLC.

e. Where possible, all data points both analog and digital associated with the PLC based loop controllers, shall be available to the operator at the workstation and fully displayed and adjustable.

f. The ladder program shall be so written that the operator, via a local or remote workstation/OIT, can select the mode in which each individual loop is to operate, i.e., manual/auto or local/remote setpoint.

g. The operator also be able to view and manually adjust all parameters such as setpoint, output, gain, integral, derivative, etc., from the workstation.

h. Once entered, the valid data shall remain stored in the controller and/or PLC until such time as new valid data is received.

2. Program Structure

a. All programming shall be implemented using ladder logic style programming only.

b. Other styles of programming, where necessary, shall only be used with the prior written permission of the Engineer and only when the task cannot be performed using ladder type logic.

c. The program shall be written using a well-organized and well documented structured approach.

d. All common elements shall be grouped together as much as possible.

e. For example, all logic for a single piece of equipment such as start/stop, indication, fault and alarm logic shall be grouped together to allow a phased or sequential startup and trouble-shooting.

3. Safeties and Interlocks

a. Upon initial startup or a subsequent restart of the controller and PLC programs shall be written as follows:

1) First initialize all logic and data

2) Second bring all equipment and controls to a safe and ready status as allowed by safety and interlock status.

3) Only when equipment is in the safe and ready status shall equipment be permitted to be started as indicated in the individual control strategies.

4) When all start permissives are satisfied, a "ready" status for each piece of affected equipment, shall be issued for display by the HMI.

b. Upon startup or restart of equipment and/or systems after a power failure, the program shall retain the status of all equipment prior to the interruption.

c. Upon restoration of stable power, with a suitable and adjustable time delay on each piece of equipment, the program shall check the status of all controlled equipment and systems for faults and/or safety trips and only then allow equipment to be started as indicated in the individual control strategies.

d. Items indicating a faulted or unsafe condition shall be immediately locked out and the appropriate alarms generated for display by the HMI.

e. Where at all possible, all preset values (for timers, counters, etc.) and variables shall be stored in register memory and shall be made available to the operator at the HMI for both display and adjustment.

D. PMCS Programming Conventions

1. General

a. The operator interface to the PMCS Software shall be through an organized system of graphic displays and tabular data displayed on the workstations, HMIs and OITs and interface units installed throughout the PMCS.

b. Graphic displays shall be based on schematic representations of the process, as shown on the Contract P&IDs and general equipment arrangement.

c. While only one of each type of similar equipment may be detailed on the P&IDs, all equipment, instrumentation and devices shall be represented on graphic displays in the level of detail depicted for the one typical equipment, device or instrument shown.

d. Displays of process equipment and piping shall be neatly laid out so as to be uncluttered and easily interpreted.

e. PMCS shall be displayed on multiple screens to allow all equipment and data to be shown clearly.

f. Displays of process piping and vessels shall be color coded to match the colors listed in the process piping schedules and shall match painting color schemes.

g. Color coding shall allow the operators to easily identify, by color, what process is being viewed.

h. If no color has been assigned to a certain process, the Contractor shall notify the Engineer who shall assign one.

i. Extensive use of animation; color and appearance change and sound shall be employed within displays.

j. Log-on and Password protection shall be required for all functions other than viewing general displays.

k. The Engineer shall decide the operator access level for each function provided by the Contractor.

2. Display System Structure

a. Displays shall be generally organized into areas based on the process with which they are associated.

b. An area index screen shall be provided showing “links” which when picked, will access all other screens in that system.

c. A general plant-wide index screen, accessible from the area index screen, having links to access all other area index screens shall be provided.

d. If previously created, the plant-wide index screen and all associated software shall be updated under this Contract to reflect the additions and/or changes made as part of this Contract.

e. All changes and updates shall be made on a plant wide basis, updating all workstations in the plant with the latest screens and information.

f. All displays throughout the PMCS shall have certain common elements. These elements shall include but shall not be limited to the following:

1) There shall be a group of quick access “buttons” located at the top of each screen.

a) Each of these buttons shall be assigned to screen within an area and shall provide a link, which when picked, will display the assigned screens.

b) When there are no alarms present on a given screen, the button shall be blank and disabled.

c) When there is any unacknowledged alarm present on a screen, its assigned button shall flash the system name in amber.

d) These screen names shall be assigned by the Engineer.

e) When the alarm has been acknowledged but is still present, the system name shall show steady amber on the button.

f) The relative position of these buttons shall not change from screen to screen within an area.

2) There shall be additional buttons provided at the bottom of each screen allowing access to frequently needed items as follows:

a) The first items shall be an alarm SILENCE button and an ACKNOWLEDGE button.

(1) The SILENCE button shall silence alarms generated on any screen from any screen.

(2) This button shall silence both workstation audio alarms and any audible devices in the field and control room.

(3) The ACKNOWLEDGE button shall only acknowledge alarms generated on that screen.

(4) All alarms and alarms not associated with a given screen, shall be acknowledged from the alarm history screen.

b) The second item shall be an ALARM HISTORY button.

(1) This button shall immediately bring up the alarm history tabular display screen with the most recent alarms on the top of the list.

c) The third common item shall be an INDEX button. This button shall immediately bring up on the display, the area index screen previously described.

d) The remaining bottom buttons shall be used to provide direct links to other screens associated with the current screen.

(1) Some of these associated screens will be defined later.

(2) When possible, buttons for links to a particular screen shall occupy the same relative position from screen to screen.

3. Equipment Control Location Status

a. Each process and piece of process equipment (pumps, grinders, blowers, fans, etc.) shall have selector switches to transfer control of the equipment from one control location to another control location.

b. The graphic representation for each unit shall have an adjacent text field indicating where the current control location is.

c. The text background shall read “CONTROL PANEL” on a blue background when control is at the workstation and read “FIELD” as appropriate on a gray background when control is elsewhere.

4. Equipment Start/Stop Control

a. All equipment started and stopped by the controller and PLC shall have an operator graphic display on one or more of the graphic display screens.

b. As indicated on the P&IDs, each piece of equipment shall have a specific method of starting and stopping inclusive of emergency stop or one or a combination of the following

1) Manual ON/OFF control

2) Manual START/STOP

3) Combination of HAND/OFF/AUTOMATIC.

c. Starting, stopping or changing operating mode of any equipment or system shall require double action followed by a confirming dialog box.

1) The operator shall “double click” on a predefined pick box within the desired equipment symbol causing a dialog box to appear.

2) The dialog box shall contain buttons for the different mode selections available to the operator for that piece of equipment or system.

3) An “OK” button shall also appear in the box which shall confirm the selection.

4) Once completed, a second dialog box shall appear to reconfirm the selection with dialog such as “DO YOU WISH TO PLACE PUMP 3 IN RUN MODE”.

5) The operator shall select a “YES” or “NO” button to confirm the selection.

6) All dialog boxes shall have a “CANCEL” button which shall leave the system unchanged.

5. Alarms

a. Provide eight (8) levels of alarming for each analog variable. There shall be high-high-high, high-high, high, deviation low, deviation high, low, low-low, low-low-low.

b. Annunciate alarm with horn provided in the HMI/s and display appropriate alarm.

c. Assign alarm to printer(s) for logging.

d. The software shall display alarm status via color change or blink in line, text, or fill attributes.

e. The software shall have both alarm summary and alarm history displays with configurable message text including: DATE, TIME, TAG NAME, ALARM EVENT, ALARM TYPE, VALUE, SETPOINT, SEVERITY.

f. The alarm summary and alarm history displays shall be configurable for color of alarm window, new alarms, ACK alarms, and RTN alarms.

g. Momentary alarms shall be reported by the software if the signal made a transition from the normal state to the alarm state and back to the normal state between the polling sequences of a remote unit.

h. Momentary normal states shall be reported by the software if the signal made a transition from the alarm state to the normal state and back to alarm state between the polling sequences of a remote unit.

i. Multiple alarm and multiple normal states shall be reported by the software if multiple transitions were made between polling sequences.

j. Alarms shall be able to be routed to screen, printer, and/or disk file.

6. Trending

   a. Software shall allow the configuration of real time trend displays which update continuously as new values are acquired.

   b. Real time trend display shall be in Variable versus Time format.

   c. Real time trend display shall support scaling of both variable and time axes.

   d. Real time trend display shall support a minimum 4 variables per graph.

   e. Software shall allow any number of real time trend graphs per screen.

   f. Software shall allow configuration of Real time trends and Historical trends on same screen.

   g. Software shall allow configuration of trend graphs and other animation (bar charts, push buttons, etc.) on the same screen.

   h. Real time trend shall support trending result of arithmetic and/or logical expressions involving Tag names by typing in the expression in the desired pen field.

   i. The PMCS supplier shall develop and assign real time trends for all monitored system analog variables, and shall submit proposed trend plot groupings as part of the system software documentation submittal.

7. Historical Data Management

   a. The PMCS shall contain a Historical Data Base Utility which provides for long term storage of data collected from remote processors or manually entered from the keyboard.

   b. The Historical data shall be collected from the real time database and from these samples.

   c. The Historical system shall be configurable to calculate the average, maximum, minimum, standard deviation and total values over sampled data time intervals configurable on a per point basis.

   d. The software shall allow for historical data to be manually entered from the keyboard to facilitate entry of lab data or other information to be used in generating historical plant performance calculations.

   e. Signal values from the Historical Data Base shall be available for graphic displays, reports and trending.

   f. The size of the Historical Data Base shall be limited only by available disk space which at minimum shall be capable of holding 6 months of data.

g. The Historical Data Management software shall provide utility routines to archive data to long term storage devices on demand, or automatically based on a user configurable time schedule.

h. The Historical Data Base shall be organized as a series of Time Classes, each of which stores sampled or calculated values over a specified time interval.

i. Up to 63 time classes shall be configurable, and each time class shall accommodate over 13,000 values.

8. Reports

a. Software shall support printing of any screen created by the PMCS Supplier, whether or not it is the current active screen used by the operator.

b. Software shall allow screen prints based on demand (i.e. push button), event, time, or combination thereof.

c. PMCS Supplier shall submit actual copies of suggested report layouts for review and approval in accordance with the requirements of this Section.

d. The process report generation software shall provide the means to process, store, and print data for historical records.

e. Configuration shall be flexible so that contents of the reports can be easily modified.

f. As a minimum, the following data collection functions shall be provided for all analog variables:

1) Instantaneous value; value at the end of the data collection interval.

2) Average value over the time interval.

3) Totalization over the time interval.

4) Highest value over the time interval.

5) Lowest value over the time interval.

g. Equipment Run Times shall be monitored, calculated and reported for all major process equipment items in the system.

h. Report data developed shall include year-to-date and month-to-date run times and starts for each item.

i. As a maximum, report data shall be collected and stored at ten minute intervals.

j. Each log report page shall have the capability to contain information for ten log points as a minimum.

k. Periodic log reports shall be printed automatically at the end of the time period.

l. A calculation extension capability shall be provided to perform calculations on data that has been accumulated for report generation.

1) Calculations shall consist of addition, subtraction, multiplication, and division functions for calculations of such items as engineering unit changes, totalization values where measurement values are different, and performance indexes.

2) Provisions shall be made for a minimum of 200 calculation extensions.

m. All reports shall be free form, thereby printing all general information, headings and data in an established format at the time of generation.

1) Pre- printed sheets shall not be acceptable.

2) Each page of a report shall have printed the plant name, type of report, date and time the report was printed, and page numbers.

n. Software shall be provided for generation of special event, hourly, daily, monthly and annual reports.

1) Reports shall be generated using process input/output, event information, analog, digital, manual and/or computed point information from records in database.

9. Process Variable Indicators and Controllers

a. Where indicated on the P&IDs, required by the specifications or wherever available, all instruments providing analog data whether real or calculated shall be graphically displayed on the screen in its relative position in the process or in tabular form as required.

b. Process indicators such as “PI”, “FI”, “TI”, “FIC”, “TIC”, etc., shall be provided with all of the following features.

1) Each “instrument” shall appear as a standard instrument “bubble” or “lollipop” containing the ISA instrument type designation.

2) The instrument tag number shall appear using the same format as the Contract Drawings.

3) When instruments of the same equipment number appear on the same screen, the loop number alone shall be sufficient provided there are no duplicate loop numbers and it is clear what equipment the instrument is associated with.

4) Adjacent to the instrument symbol, the current "real time" value of the variable, in engineering units, shall be displayed.

5) Next to this shall appear the appropriate units.

c. All analog values, whether real or calculated, shall have alarm points configured in the software.

1) Those of a critical nature or where used to control equipment shall have this performed in the local controller and PLC while being set and monitored from a remote point.

2) While within the normal range, variables shall appear in black.

3) When the variable moves outside the normal range, the text shall flash in red and the bubble shall flash amber.

4) Once acknowledged, both will cease flashing and remain steady colors until the condition is corrected.

5) A signal out of range or containing invalid data shall cause the text to display question marks on a flashing red background.

d. The operator shall be able to "double click" the instrument symbol and cause a dialog box to appear.

1) This box shall contain the full tag number of the instrument, measured variable name (i.e. Return Sludge Pump 1 Flow), calibrated range and current alarm points.

2) One button shall be provided in the box to edit the alarm setpoints.

3) A second button shall allow the operator to display a trend graph, on a partial screen, of the variable against a time base of minutes, or hours (selectable).

10. Accumulators

a. Provide HMI configuration for accumulations.

1) Include run time for each piece of equipment.

2) Include number of starts for each motor.

3) Include totalized values for all flows.

11. Security

a. System Protection from unauthorized access to the PMCS interfaces shall be provided by means of software and hardware interlocks.

b. Provide [eight (8)] levels of security.

c. Software interlocks shall provide a minimum of two levels of security, Operator and Process/System Engineer.

d. Operators shall only be permitted access to PMCS HMI software allowing only operating and configuration of equipment for operational actions only, such as start, stop, modes changes such as local and remote, placing multiple items of similar equipment in and out of service, generating trends, dealing with alarms and all actions required by Operators to maintain processes 24 hours a day, 365/366 days a year.

e. Only Process/System Engineers shall be allowed to exit the HMI software and access the operating system and other resident software applications for hardware and software operating system, controller/PLC programming and editing.

f. Program editing access shall require entry of a minimum eight character entry code assigned within the controller program.

g. All PMCS users shall be required to log on to the LAN network and PMCS Software interface with a predefined user name and password before access to operate or modify the system can be obtained.

h. All defined user names shall be associated with a set security level.

i. Each display shall be assigned a security level required to access it.

j. All signals and control functions shall have separately assignable security levels required for viewing functions signal value change functions to restrict control access where required or desired.

k. McAfee antivirus software and Cisco networking software shall be provided.

l. System software and remote monitoring shall conform to the requirements of the BWT Enhanced Pumping Station Monitoring Guidelines.

3.03 FIELD TESTING / QUALITY CONTROL

A. PMCS Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. PMCS Monitoring and Control Criteria specified under this Section shall be verified during PMCS Startup and Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the correct implementation of the PMCS Monitoring and Control Criteria specified under this Section.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 61 96 – PMCS CONTROL STRATEGIES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall furnish Control Strategy diagrams, configuration sheets and Control Strategy descriptions as Shop Drawings for approval.

B. The Contractor shall perform all programming, configuration and tuning required to implement each Control Strategy listed in this Section.

C. The following index of this Section is presented for convenience:

D.

Article	Title	Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	4
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	14
3.01	Examination / Preparation	14
3.02	Installation	14
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	14
3.05	Adjusting / Protection / Cleanup	14

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 26 05 53 – Identification for Electrical Systems.

B. Section 26 29 13 – Enclosed Controllers.

C. Section 26 43 13 – Low-Voltage Surge Protective Devices

D. Section 40 61 13 – PMCS General Requirements.

E. Section 43 23 31.05 – Vertical Centrifugal Pumping Units

1.04 REFERENCES

A. Definitions

1. CS - Control Strategy

2. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. The Control Strategies in this Section are written descriptions of the basic configuration and/or programming required to implement regulatory and sequential control of the unit processes as shown on the P&IDs.

B. The Control Strategies do not in all cases describe the process characteristics fully, many of which may only become apparent during shop drawing assembly or during start-up.

C. For PMCS, Control Strategies shall fully reside in the memory of the designated PLC. For hardwired Backup System Control Panel, Control Strategies shall be implemented by relay logic and not PLCs.

D. The process inputs/outputs referred to in the Control Strategies are all shown on the P&IDs.

E. Any additional I/O (Maximum 20%) required shall be added during Shop Drawing Review and shall be provided at no additional cost to the City.

F. Process Control Functions

1. Process control function shall be structured to permit the realization of all Control Strategy requirements.

2. Each control function shall be designed so that bumpless, balance free transfers are obtained during operating mode changeover and/or initialization.

3. Where applicable, user-changeable parameters shall be automatically defaulted to a preset value if a specific value is not given during system generation.

4. Provision shall be made to include certain control functions that apply to all analog inputs, virtual variables, analog controllers and discrete control whether or not shown on the P&IDs, even though one or more of the functions may be disabled by the user for a given data base point:

a. Analog Data Scaling

1) This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span.

2) The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero span values in the data base.

b. Amplitude Limit Check

1) This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits.

2) The control function shall determine the time at which each limit excursion occurred.

3) A deadband shall be provided on each limit and shall be expressed as a percentage of span or in engineering units.

4) Low and high limiting default values will be set-up for each measured or calculated variables used in the process control loops.

c. Engineering Unit Conversion

1) This control function shall convert scaled analog data to engineering units by means of the following equation:

a) $Y = ((H - L) (D/DH) + L)$ where

Y is the value in engineering units.

H is the high value of span, expressed in engineering units

L is the low value of span, expressed in engineering units.

D is the digitized scaled input value in counts.

DH is the full scale digitized value in counts

d. Manual Control

1) It shall be possible for [operator] or [plant engineer] to interrupt any sequence, loop or automatic operation and operate the same manually through [operator workstation].

e. Verification of Digital Outputs

1) This control function shall verify that the equipment has responded to the digital commands before proceeding to next step during automatic operation.

2) If any discrepancy is detected, an alarm will be annunciated.

G. Hardware

1. The Contractor shall provide all the hardware, whether or not shown or specified, that may be necessary to implement the Control Strategies as described in this Section or the Contract Documents.

H. Configuration

1. All set points, tuning parameters and engineering scales, etc., shall be documented for each control point and each control strategy on configuration sheets or similar documents.

2. These documents shall be updated during factory testing and finally during start-up.

I. Control Strategy Displays

1. Control Strategy displays shall be submitted for review.

2. Displays shall clearly show initial conditions, start, and progression of the control strategies.

3. Each Control Strategy shall be displayed in a minimum number of displays for ease of monitoring by the operator.

J. Power Failure

1. Pumping Station equipment controlled by the PLC shall be programmed to automatically reset upon failure.

K. Restart

1. All equipment and motors shall be automatically restarted after power failure by the control system in an orderly fashion approved by the Engineer.

2. Final approval of the restart sequence shall be given by the Engineer during factory testing and start-up.

L. Position indication of Gates and Valve in transition.

1. Open pilot lights and indicators in/at all Control Stations and HMIs shall blink when a gate or valve is in the open transition and shall stay steady on when fully open.

2. Closed pilot lights and indicators in/at all Control Stations and HMIs shall blink when a gate or valve is in the closed transition and shall stay steady on when fully closed.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements.

1.07 SUBMITTALS

A. Control Strategies detailed in this Section shall be submitted for approval by the Engineer.

B. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Control Strategies shall be implemented by:

1. PMCS Supplier for PMCS-9110 and RTU-9130.
2. MSP Vendor for MSPCP-1600 and BSCP-9120 (part of pump package).

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Control Strategy CS-01

1. TITLE: Wet Well Primary and Secondary Level Systems
2. DRAWING: I-103
3. DESCRIPTION: Monitoring and Control of Wet Well Level by Primary and Secondary Level Systems

a. Primary Level transducer LE/LIT-027 and Secondary Level transducer LE/LIT-028 continuously measure wet well level through the Main Sewage Pumps Control Panel MSPCP-1600.

b. Control logic for each transducer is implemented in the MultiSmart controller housed in MSPCP-1600.

c. From the continuous level measurement, the Controller derives ten (10) level setpoints (adjustable) in each system for controlling the six Main Sewage Pumps (MSPs) and for generating wet well low-low (LALL) and high-high (LAHH) level alarms.

d. Both level systems operate at the same elevation in the wet well at established control elevations or level setpoints.

e. Either system could be made the primary system with the use of a manual selector switch, thereby making the other system the secondary system.

f. Time delays are built into the pump control logic system to preclude all pumps from starting simultaneously in the event of transfer of level control system.

g. A closed-circuit television (CCTV) system with cameras above the Wet Well will allow operators to view the wet well area and level transducers above the influent level (not submerged) from monitors located in the Electrical Room.

4. INTERLOCKS AND ANNUNCIATION

a. Provide alarm and control setpoints as follows:

1) Level 1 – Send low-low level alarm.

2) Level 2 – Stop all MSP motors.

3) Level 3 – Start lead MSP.

4) Level 4 – Start first lag MSP.

5) Level 5 – Start second lag MSP.

6) Level 6 – Start third lag MSP.

7) Level 7 – Start fourth lag MSP.

8) Level 8 – Start fifth lag MSP

9) Level 9 – Send high level alarm. Automatically transfer to the secondary level system.

10) Level 10 – Send high-high level alarm. Automatically transfer to the backup level system.

b. In any mode of operation (manual or auto), an alarm shall be displayed at the MSPCP-1600 HMI and PMCS-9110 HMI until the alarm condition is cleared and acknowledged by the operator.

5. FUNCTIONAL DESCRIPTIONS

a. Local Auto/Manual Operation

1) There are no local (wet well area) auto/manual operations of Primary and Secondary Level Controls.

b. Remote Manual Operation (From HMI in MSPCP-1600)

1) Adjust level alarm and control setpoints (water levels or elevations in wet well).

2) Adjust time delays in the pump control logic to preclude all pumps from starting simultaneously in the event of transfer of level control system.

c. Remote Automatic Operation (From MSPCP-1600)

1) Start and stop MPSs. (See par. 2.03B.4.a. above and Control Strategies CS-04 and CS-05.).

2) Continuously measure and graphically display wet well levels, level control setpoints, and level alarms from primary and secondary level systems.

3) Retransmit wet well level, level control setpoints, and level alarms to PMCS-9110 and RTU-9130.

B. Control Strategy CS-02

1. TITLE: Wet Well Backup Level System

2. DRAWING: I-103

3. DESCRIPTION: Monitoring and Control of Wet Well Level by Backup Float Switches and Backup System Control Panel

a. Backup Float Switches take over control of MSPs and wet well level upon wet well high-high level alarm (LAHH), due to possible failure of both primary and secondary level control systems (see Control Strategy CS-02).

b. Backup Float Switches are hardwired to the Backup System Control Panel (BSCP-9120).

c. Seven (7) level float switches control the three Main Sewage Pumps (MSPs) and generate wet well low-low level alarm (LALL), high level alarm (LAH), and high-high (LAHH) level alarm.

d. Backup level system operates at the same established level control elevations as the primary and secondary level systems.

e. Time delays relays are hardwired into the pump relay control system to preclude all pumps from starting simultaneously in the event of transfer of level control system.

f. A closed-circuit television (CCTV) system with cameras above the Wet Well will allow operators to view the wet well area above water level from monitors located in the Electrical Room. Backup float switches are submerged in wet well water and are not visible from the CCTV.

4. INTERLOCKS AND ANNUNCIATION

a. Provide alarm and control setpoints as follows:

1) Level 1 – Send low-low level alarm.

2) Level 2 – Stop all MSP motors.

3) Level 3 – Start lead MSP.

4) Level 4 – Start first lag MSP.

5) Level 5 – Start second lag MSP.

6) Level 6 – Start third lag MSP.

7) Level 7 – Start fourth lag MSP.

8) Level 8 – Start fifth lag MSP

9) Level 9 – Send high level alarm. Automatically transfer to the secondary level system.

10) Level 10 – Send high-high level alarm. Perform emergency manual operation of MSPs using MSP Local Control Stations (LCSs), if operation by any other level system is not restored.

b. Indicate status and alarms at BSCP-9120:

1) "Backup Active"

2) "Backup Not in Auto"

3) "Wet Well Level Low-Low"

4) "Wet Well Level High"

5) "Wet Well Level High-High"

c. In any mode of operation (manual or auto), activate and maintain any alarm at the BSCP-9120 and RTU-9130 until the alarm condition is cleared and acknowledged by the operator.

5. FUNCITONAL DESCRIPTIONS

a. Local Auto/Manual Operation

1) There are no local (wet well area) auto/manual operations of Backup Level Controls.

b. Remote Manual Operation (From BSCP-9120)

1) Set the Backup mode selector switch to "B/U". The backup float switches and BSCP-9120 monitor and control wet well level and MSPs.

2) Set the Backup mode selector switch to "AUTO". The primary or secondary level system with MSPCP-1600 monitor and control wet well level and MSPs. This is the normal mode of operation.

3) Set the Backup mode selector switch to "OFF". The backup float switches and BSCP-9120 are disabled from controlling wet well level and MSPs. The "OFF" position also serves to reset the backup system alarms.

4) Select MSP control sequence using the six-position Pump Sequence Selector.

c. Remote Automatic Operation (From BSCP-9120)

1) See par. 2.03C.4.a. above and Control Strategies CS-02.

2) Send status and alarms to RTU-9130.

C. Control Strategy CS-03

1. TITLE: Main Sewage Pumps

2. DRAWING: I-104

3. DESCRIPTION: Monitoring and Control of Main Sewage Pumps

a. Main Sewage Pumps MSP-1601, MSP-1602, MSP-1603, MSP-1604, MSP-1605 and MSP-1606 have built-in Pump Electronic Module (PEM) that monitors various parameters in the pump and motor, and then sends these signals to the base unit (BU) of the MAS-801 pump monitoring and protection system in the MSPCP-1600.

b. From each PEM, the signals are sent via a communication cable running along the power cables, that combine into the SubCab submersible cable included in the pump motor package.

c. Each MSP has a Power Analyzer (PA) located in the MSPCP-1600 that monitors electrical parameters and is a part of the MAS-801 system.

d. The MSP motor controllers, wet well primary and secondary level systems (see Control Strategy CS-02) are monitored and controlled by MultiSmart Controllers in the MSPCP-1600.

e. Each MSP motor controller is a reduced-voltage solid-state starter (RVSS) located in the motor control center (MCC) in the MCC Room.

f. Each MSP also has local control station (LCS) with “Emergency Stop” pushbutton located near its associated pump in the dry well pump area.

g. Each MSP discharge has a check valve, manually-operated discharge valve, pressure indicating transmitter that monitors pump discharge pressure, and flow indicating transmitter that continuously measures the flow rate or the pump.

h. High service MSP-1601, MSP-1601 and MSP-1603 discharge into a common discharge header and each of these MSPs have vacuum priming systems VS-7401, VS-7402 and VS-7403. The high service MSPs common discharge header has a pressure indicating transmitter, and a magnetic type flowmeter and transmitter.

i. Low service MSP-1604, MSP-1605 and MSP-1606 discharge into a common discharge header that has a pressure indicating transmitter, and a magnetic type flowmeter and transmitter.

j. A closed-circuit television (CCTV) system with cameras in the dry well lower level pump area, and the Electrical Room will allow operators to view the MSPs, LCSs, and RVSSs from CCTV monitor located in the Electrical Room.

4. INTERLOCKS AND ANNUNCIATION

a. Pump-motor parameters monitored by MAS-801:

1) Motor Temperature, 3 phases
2) Main Bearing Temperature
3) Support Bearing Temperature
4) Stator Housing Leak
5) Water in Oil
6) Vibration, 3-Axis

b. Electrical parameters monitored by Power Analyzer:

1) Current, 3 phases
2) Current Imbalance
3) Voltage, 3 phases
4) Voltage Imbalance
5) Power Factor
6) Power (kilowatts)
7) Energy (kilowatt-hours)

c. Monitored and Controlled by RVSS/Bypass Starter in MCC:

1) RVSS Running/Stopped
2) RVSS Fail/Overload
3) Bypass Starter Running/Stopped
4) Bypass Starter Overload
5) RVSS/Bypass Starter Control Voltage
6) MSPCP Permissive and Alarm
7) Pump motor thermal switch
8) Pump discharge high pressure
9) Emergency stop near pump
10) Pump Check Valve Open/Closed Status

d. Monitored and Controlled by MSPCP

1) Pump Auto Start-Stop Control
2) Pump in Auto
3) Control Power Available
4) Pump Running/Stopped
5) Pump Run Time and Number of Starts
6) Pump Fault
7) Pump Not in Service
8) Pump Check Valve Open/Closed Status
9) Pump Discharge Pressure Measurement
10) Pump Discharge High Pressure
11) Pump Flow Rate Measurement
12) Primary and Secondary Level Systems
13) RVSS Running/Stopped
14) RVSS Fail/Overload
15) Bypass Starter Running/Stopped
16) Bypass Starter Overload
17) RVSS/Bypass Starter Control Voltage & Alarm
18) MSPCP Alarm

e. In any mode of operation (manual or auto), activate and maintain any alarm at the MSPCP-1600 and RTU-9130 until the alarm condition is cleared and acknowledged by the operator.

5. FUNCTIONAL DESCRIPTIONS

a. Local Manual Operation near MSP

1) In case of emergency in the pump or pump area, press the Emergency Stop pushbutton.
2) To lockout the pump-motor in addition to circuit breaker lockout and tagout (LOTO) at MCC, press Emergency Stop pushbutton and attach LOTO.

b. Manual Operation of MSP Discharge Valve

1) MSP discharge valve is all mechanical with no electric actuator.
2) If necessary, open or close the valve manually at the valve in accordance with the manufacturer's instructions.

c. MSP Check Valve Position Indications

1) MSP check valve has mechanical indicators to indicate whether the valve is open or closed.

2) Also, MSP check valve is provided with proximity or limit switches hardwired to send valve open or closed position signals to MSPCP-1600.

d. Remote Manual Operation from MSP-1600

1) For manual testing or in case of failure of all three level control systems, use manual control and indicating devices on the center area of the front door of MSPCP-1600.

2) Observe that the "Control Power Available" indicating light is "on" for the MSP to be manually operated.

3) Manually set the Hand-Off-Auto (HOA) selector switch to "Hand" position.

4) Manually switch the Start-Stop (S-S) selector switch to "Start" position to run the pump. "Pump Running" indicating light will turn on when the pump starts.

5) HOA and S-S switches maintain their positions through power interruption, if any. Pump will automatically restart when power is restored with the switches left in "Hand" and "Start" positions.

6) To stop the pump, manually switch the S-S selector switch to "Stop" position. "Pump Stopped" indicating light will turn on when the pump stops.

7) To restore normal operation, return the HOA selector switch to "Auto" position.

e. Remote Automatic Operation from MSPCP-1600

1) See Control Strategy CS-01 – Primary and Secondary Level System.

2) Transmit pump-motor parameters, electrical parameters, status and alarm signals to MSPCP-1600, PMCS-9110 and RTU-9130.

f. Remote Manual and Automatic Operation from BSCP-9120

1) See Control Strategy CS-02 – Backup Level System.

D. Control Strategy CS-04

1. TITLE: Ralph Avenue Sewer Influent Flow Control

2. DRAWING: I-103

3. DESCRIPTION: Monitoring and Control of Ralph Avenue Sewer Influent Flow by Ralph Avenue Inlet Gate

a. Influent flows through the 72" sewer from Ralph Avenue to the Ralph Avenue Inlet Bypass Chamber, through the Ralph Avenue Inlet Gate, and into the wet well.

b. In the Ralph Avenue Inlet Bypass Chamber, a submersible transducer (similar to primary and secondary level transducers) continuously monitors and translates pressure or level to flow rate tagged FE/FIT-026.

c. Contractor shall calibrate actual flow rates and corresponding levels or pressure readings in the PMCS.

d. When Ralph Avenue Sewer influent flow rate hits 50 mgd, or is projected to exceed 50 mgd, the PMCS will send flow control signals to modulate or slightly close the Ralph Avenue Inlet Gate actuator such that the flow rate would not exceed 50 mgd.

e. PMCS monitors the sum of the high service header flow and low service header flow. PMCS obtains Avenue M Pump Station flow data from CCFISS. The difference between the two flows is the Ralph Avenue Sewer influent flow, which provides feedback to flow control modulation of Ralph Avenue Inlet Gate.

4. INTERLOCKS AND ANNUNCIATION

a. Provide alarm and control setpoints as follows:

1) Ralph Avenue Sewer Influent Flow Rate at 50 mgd or more.

2) Flow rates through high service discharge header.

3) Flow rates through low service discharge header.

4) Total flow through Paerdegat Pumping Station: sum of high service flow and low service flow.

5) Influent flow from Avenue M Pumping Station obtained from CCFISS to PMCS-9110.

6) Influent flow from Ralph Avenue Sewer: from total flow through Paerdegat Pumping Station, subtract influent flow from Avenue M Pumping Station.

b. In any mode of operation (manual or auto), an alarm shall be displayed at the PMCS-9110 HMI until the alarm condition is cleared and acknowledged by the operator.

5. FUNCTIONAL DESCRIPTIONS

a. Local Auto/Manual Operation (from Ralph Avenue Inlet Gate LCP-1301-48-S):

1) Set the "LOCAL-REMOTE" selector switch to "LOCAL".

2) Use "OPEN-STOP-CLOSE" selector switch to manually modulate the Ralph Avenue Inlet Gate.

3) Observe gate position indicator and indicating lights.

b. Remote Manual Operation (From HMI in PMCS-9110)

1) Ralph Avenue Inlet Gate LCP-1301-48-S, "LOCAL-REMOTE" selector switch is set to "REMOTE".

2) On HMI, use "OPEN-STOP-CLOSE" control buttons to manually modulate the Ralph Avenue Inlet Gate.

3) On HMI, observe gate position, gate status and flow rates.

c. Remote Automatic Operation (From PMCS-9110)

1) Ralph Avenue Inlet Gate LCP-1301-48-S, "LOCAL-REMOTE" selector switch is set to "REMOTE".

2) See paragraph 2.03 D.3. above.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop Tests

1. Shop Testing shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 63 43 – PMCS PROGRAMMABLE LOGIC CONTROLLERS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish, install, calibrate, test, startup, and place into satisfactory operation PMCS PLCs, HMIs, HMI Software, and PPU.

B. The PMCS Supplier shall provide on behalf of the Contractor all configuration and documentation of all PMCS PLCs, HMIs, HMI Software, and PPU.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	19
PART 3	EXECUTION	20
3.01	Examination / Preparation	20
3.02	Implementation	20
3.03	Field Testing / Quality Control	22
3.04	Startup / Demonstration	22
3.05	Adjusting / Protection / Cleanup	22

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 61 95 – PMCS Monitoring and Control Criteria.

C. Section 40 61 96 – PMCS Control Strategies

D. Section 40 80 82 – PMCS Startup and Field Testing

1.04 REFERENCES

A. Definitions

1.	Peer-to-Peer	-	Communication between devices connected to a common channel where each device can control the communication exchange.
2.	PID	–	Proportional, Integral and Derivative, a description of controller action which modifies the response to an input signal and a set point such that the output rapidly and optimally achieves the set point.
3.	PPU	–	Portable Programming Unit
4.	Section 40 61 13	–	PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

B. Reference Standards

1.	Section 40 61 13	–	PMCS General Requirements lists the standards applicable to this Section and the PMCS.
2.	IEEE 37.90.1	–	IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
3.	NEMA ICS 61131-1	–	Programmable Controllers Part 1: General Information.
4.	NEMA ICS 61131-4	–	Programmable Controllers Part 4: User Guidelines.
5.	IEC 61131	–	Programmable Controllers

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. All materials and equipment furnished shall be new, free from defects, and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of PLCs, HMIs, HMI Software, and PPU.

C. Manufacturers shall have produced PLCs, HMIs, HMI Software, and PPU for a minimum of 20 years.

D. Where there is more than one item of similar equipment required under the Contract, all such similar equipment shall be the product of one manufacturer.

E. All material furnished under this Contract shall be determined safe by either Underwriters Laboratories, Inc., or Factory Mutual Engineering Corporation and all material shall be labeled, certified, or listed by the testing agency.

F. Custom made equipment or related installation which are constructed specially for this Project will not be acceptable.

G. Equipment furnished within this Contract shall be standard products furnished by a supplier regularly engaged in the manufacture of such products.

H. The PMCS Supplier shall utilize System and Software engineers who have been factory trained and certified on the respective software packages, to perform all programming functions, develop control strategies, create graphic displays, customize applications, document all work and coordinate the software interface.

I. System and Software engineers shall be intimately familiar with the details of thisPumping Station, instrumentation and control in general and the Contract goals and requirements.

J. System and Software engineers shall have a minimum of 10 years' experience in the PMCS development work required under this Contract.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. The PMCS Supplier shall submit, through the Contractor, the following information for approval prior to beginning of the actual work of developing software for this Contract:

1. Qualifications and certifications of system software engineers.

2. A listing of all proposed software packages indicating quantities and where they will be installed.

3. Preliminary ladder logic for all controllers and PLCs and general methods of implementing the various control strategies.

4. Preliminary database and I/O listing showing system tag names and references.

5. Preliminary screen display count with general system structure.

6. Preliminary screen display development, general display organization and common components.

C. The PMCS Supplier shall submit all completed items to the Engineer for review and approval. As a minimum, the items to be submitted shall include, but shall not be limited to:

1. PLC ladder logic with full documentation and annotation
2. Full Color copies of all unique Graphic display screens
3. Screen animation and control
4. Databases
5. Alarm and event log lists, formats and messages

D. Submittals shall be made at least 60 days in advance of any proposed use by the PMCS Supplier.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall comply with spare parts, special tools and supplies listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Spare parts and tools shall be as recommended by the manufacturer and shall as a minimum include the following:

1. Four (4) I/O modules for each type furnished.
2. Two (2) communication modules (Ethernet, Remote I/O, PLC LAN) for each type furnished.
3. Two (2) CPUs of each size and type furnished.
4. One (1) PLC rack of each type and size furnished.
5. Two (2) power supplies of each size furnished.
6. One (1) PLC for each type furnished.
7. All spare parts recommended by manufacturer and listed as recommended spare parts in the manufacturer's submitted O&M Manual.
8. Tools
    a. Furnish all tools necessary to service, disassemble, repair, and adjust the equipment.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Schneider Electric, Andover, MA;
2. No substitution allowed.

B. PMCS PLC OITs/HMIs shall be as manufactured by:

1. Schneider Electric (Harmony GTU), Andover, MA;
2. Rockwell/Allen-Bradley (PanelView Plus 7), Milwaukee, WI
3. No substitution allowed.

C. HMI Software shall be as manufactured by:

1. Aveva/Wonderware (InTouch HMI), Lake Forest, CA
2. No substitution allowed.

D. PPUs shall be as manufactured by:

1. Dell (Latitude 7330 Rugged Extreme Laptop), Round Rock, TX;
2. No substitution allowed.

2.02 MATERIALS / EQUIPMENT

A. General

1. The PMCS PLCs shall implement and provide the Control Strategies specified in Section 40 61 96 – PMCS Control Strategies.
2. Where shown on the Contract Drawings redundant PLCs configured in hot standby arrangements shall be provided.
3. The PLC shall be configured by the Contractor to perform functions shown and specified. The Contractor shall coordinate and obtain from all equipment suppliers PLC systems of the same manufacturer and series.
4. Functions to be performed by the PLC include but are not necessarily limited to the following:
    a. Alarm and status indication.
    b. PID control and arithmetic functions.
    c. Interlock and sequential logic control of processes and equipment operations.
    d. Collection and transmission of data and control parameters to and from other PLCs.
    e. Provide a dry contact rated 2 amperes at 120-volt a-c for remote indication of processor failure.

5. The PLC shall be microprocessor type furnished with all necessary relays, timers, counters, and latches as data manipulative functions and arranged into the format required to accomplish the functions shown and specified.

6. The PLC shall be designed and constructed for the demanding requirements of real-time process management and control on a continuous basis for use in a Pumping Station.

7. The manipulative functions shall have the capability of being rearranged into any desired format while the controller is performing other control tasks.

8. Expansion of the controller by the input/output points, internal data manipulative functions, and relays, timers and counters shall be accomplished by reprogramming.

9. The control programs and applications memory of the PLC shall be capable of being remotely (off-line) and locally (on-line) monitored, programmed, modified and displayed by use of a personal computer and documentation software which shall be provided as part of this Contract.

10. In addition, the PLC shall be capable of being programmed by an external PC compatible host device via an Ethernet communication port. The host communication interface shall allow controlled access for authorized users via password protection to all registers, I/O system fault status and I/O override.

11. The logic shall be entered and displayed in ladder diagram format.

12. The ladder diagram format shall contain a complete cross reference with each coil referred to in logic and identified as normally open or normally closed.

13. Mnemonic information shall be added to each coil and to both real and internal I/O points. Alphanumeric titles and descriptions shall appear on the screen.

14. Any restructuring of the control logic shall be done at the PLC installation and shall not necessitate any removal components of the PLC to another location.

15. The PLC construction shall be that of a modular type design.

16. All inputs, outputs, and logic control interface units shall be easily removed for ease in replacement or restructuring the hardware arrangement.

17. Shut down of the processor control logic (halting of program scan) shall not occur if I/O or Remote I/O modules are removed.

18. In the event of a power failure or malfunction of the logic hardware, the controller shall provide dry, Form C contact closures for remote and local indication and alarming.

19. A self-diagnostics package to determine proper processor operation shall be included. Diagnostic LED shall be provided in clear view on the front of the PLC enclosure.

20. Changing an on-line control logic process operation shall not necessitate the halting of the processor.

21. Burn-in for all printed circuit boards and modules shall be performed at the factory.

22. Programmable Logic Controllers shall conform to NEMA ICS 61131 – 1 and NEMA ICS 61131 – 4

23. The primary interface to the process equipment and field devices shall be provided by the input/output system consisting of I/O modules installed in the PLC backplane, chassis or remote mounting racks.

24. The input/output system hardware shall be designed with the following features:

    a. Noise immunity and filtering.

    b. IEEE surge-withstand rating to IEEE 37.90.1

    c. Optical isolation for all inputs and outputs to provide controller logic protection.

    d. No on board pots requiring adjustment or maintenance.

    e. Any card, any slot, plug-in packaging, with locking bars and/or screws to hold I/O modules in place.

    f. 600 volt, screw type, field wiring terminal strips sized to accommodate a minimum of two # 14 AWG wires per terminal within control panels and MCCs.

    g. Terminal strip design shall allow I/O module removal and replacement without disturbing wiring connections.

    h. Front-of-module LED status indicators for each individual I/O point to indicate when power is applied at I/O terminals.

    i. Individually fused output circuits for all output modules.

    j. Output fuses shall be capable of being inspected without removal of and replaced without disassembly of the output module.

    k. Individually isolated output modules shall be provided with front-of-module blown fuse LED status indicators for each output point.

    l. Non-isolated (common output power source) output modules shall be provided with common blown fuse LED status indicators for a maximum of every four points.

    m. All outputs for contactors and relays shall be rated for a minimum of 2.0 amps continuous at 120 VAC.

n. Where higher rated outputs are required interposing relays located inside control panels shall be provided in order to assure that ratings of the PLC output contacts are not exceeded.

o. For outputs to motor contactors and other equipment type load relays, provide transient and inrush surge suppressor connected across the output contact terminal and the neutral common terminal inside the control panel to suppress the switching surge transient to lower than the continuous rating of the output contacts.

p. The maximum number of points per I/O module shall be as follows:

1) Discrete: 16.

2) Analog: 8.

q. The following types of I/O modules shall be provided for use with the supplied PLC System:

1) Analog Inputs (12 bits minimum):

a) 0-10 VDC.

b) 1-5 VDC.

c) 4-20 mA DC (250 ohms maximum impedance).

d) Millivolt signals.

2) Analog Outputs (12 bits minimum):

a) 4-20 mA DC (load of750 ohms minimum).

b) 0-10 VDC.

c) 1-5 VDC.

3) Register Inputs and Outputs (16 bit):

a) Single BCD.

b) Multiplexed BCD.

4) Discrete Inputs:

a) 5 V, 12 V, 24 V, 48 V and 120 VAC/DC in both isolated and common circuit types.

b) TTL Logic.

5) Discrete Outputs:

a) 120 VAC in both isolated and common circuit types.

b) 12-120 VDC.

c) Form C Relay Contacts.

d) TTL Logic.

6) High Speed Encoder/Counter:

a) Accept and count pulse inputs independently and unaffected by I/O scan or program scan.

b) Minimum pulse rate of 50 kHz.

7) Remote I/O

a) Remote I/O shall be provided where shown on the Contract Drawings or the PMCS Block Diagrams or where recommended by the manufacturer to reduce the level and quantity physical wiring at the PLC location.

b) Remote I/O shall be either PLC rack type I/O or intelligent field modules, as manufactured by the PLC manufacturer.

c) Remote I/O processor or communication modules shall be modular and individually replaceable.

d) Remote I/O shall communicate with PLC CPU using the PLC manufacturer's communication bus for remote I/O.

e) All required cabling shall be furnished under this Contract for use in/with the conduit system as indicated on the Contract Drawings.

(1) Provide adequate lengths.

(2) Cabling will be installed under the Electrical Contract.

25. Signal and control circuitry to individual I/O boards shall be arranged such that a board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.).

26. Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

B. Required PLC Features:

1. Construction

a. Modular printed circuit boards.

2. Type

a. Electronic components with central processing unit and software reprogramming capabilities.

3. Memory

a. System Memory

1) Electrically Erasable Non-volatile type (EEPROM) or Lithium battery-backed RAM with minimum retention time of 2 years under worst case conditions.

b. Application Memory:

1) Type, Lithium Battery-backed RAM with minimum retention time of 2 years under worst case conditions, or RAM with EEPROM or NOVRAM backup modules.

2) Size, as required for present and dedicated future I/O capacity and for performance of the specified functional requirements plus 25 percent spare capacity as a minimum.

4. Language Format

a. Ladder type diagrams and functional blocks.

5. Provide type and quantity of I/O as required to perform the operational and functional requirements plus 20 percent spare (minimum of one module) for each type of I/O module used.

6. Spare I/O points shall be mounted and wired ready for use and shall require only field wiring connections and software configuration to place the point in service.

7. Internal Functions

a. Relays, timers, counters, latches, internal storage registers, and other functions as required to perform specified functional requirements plus 25 percent spare capacity.

8. Report Generation

a. Processor shall have the capability to store and automatically communicate up to 198 ASCII status/alarm/diagnostic type messages to a peripheral display device via the RS-232C output port at rates up to 19.2 K bits/second.

9. Security Features

a. Key switch interlock on PLC and/or security password protection through system programmer terminal to prevent tampering of logic sequences and unauthorized programming.

10. Processor Scan Time

a. 0.3 to 2 ms per kbytes of memory typical.

b. No more than one word shall be required for each contact or coil including address, no more than one word for a branch, no words for spaces or connects, and no words shall be required to begin a new rung.

c. Scan time refers to nominal memory scan time of words of relay ladder logic, with an "immediate I/O" command to operate on instantaneous alarm information.

d. Unprogrammed memory shall not be scanned.

11. Operating Temperature

a. 32 ^{0}F to 140 ^{0}F.

12. Storage Temperature

a. Minus 40 ^{0}F to 160 ^{0}F.

13. Power Supply

a. 120 VAC, with circuit breaker protection.

b. Supplies shall be sized for a minimum of 130 percent of maximum simultaneous current draw.

c. Comply with requirements specified in with Section 40 61 13 – PMCS General Requirements.

14. Data Communications

a. The PLCs provided shall be capable of Peer-to-Peer communications with other PLCs of the same and different types by means of manufacturer standard data highway system.

b. Highway system design shall be a token-passing, master less, high-throughput serial communication bus which connects the PLCs by means of intelligent network interface modules at highway drops.

c. Minimum local highway speed shall be 50 Kbaud and highway system design shall be upwardly compatible with the MAP standard.

d. All PLCs shall be provided with Ethernet networking capability using TCP/IP protocol. All modules required shall be supplied.

15. Clock

a. Battery-backed clock with typical variation of ±20 sec. per month.

16. Programming/Documentation Software

a. Provide PLC programming/documentation software package which shall be fully menu-driven and self-prompting.

b. Package shall provide fully integrated ladder diagram programming and documentation.

c. The package shall allow 3 lines of mnemonics per ladder element with 6 characters per line minimum. The package shall also provide for the inclusion of the following documentation information for ladder diagram contacts and coils:

1) Panel I/O wiring list.

2) Rack number.

3) Module position slot number.

4) I/O module type.

5) Terminal number and wire number.

6) Electrical and Mechanical Drawing Reference Number.

7) Description of up to 240 characters in length for each element.

d. The programming/ documentation software displays shall allow the user to flip between documentation and the uncommented rung as it resides in the controller.

e. Software shall also allow selection of single rung and continuous ladder diagram printouts.

17. PLC Configuration

a. PLC types shall be as designated on the PMCS Block Diagram and this Section.

b. Memory and processor shall be adequate for all control functions specified.

18. PLC Minimum Performance Requirements

a. The table below lists the minimum requirements for various sizes of PLC.

PLC Type	Micro	Small	Mid-Size	Large
I/O Discrete Points	14	960	4096	12000
I/O Analog Points	3	96	2048	8000
Memory	3 kB	6 kB	96 kB	440 kB
Scan time	3 ms/kB	2.5 ms/kB	0.3 ms/kB	0.3 ms/k

C. PLC OITs/HMIs

1. PLC OITs/HMIs (HMIs) shall comply with Section 40 61 95 – PMCS Monitoring and Control Criteria.

2. Acceptable Products:

a. Harmony GTU, 15-inch color graphic flat screen, Touch Smart XGA, coated display by Schneider Electric; or

b. PanelView Plus 7, Model 2711P, 15-inch color graphic touchscreen display by Rockwell Automation/Allen-Bradley.

3. HMI Construction

a. The operator interface terminal shall combine the display, logic communication, and power into one base unit in a fixed hardware configuration.

b. The operator interface terminal shall be designed with interchangeability provided for similar models with 4-inch to 15-inch screen sizes.

c. The operator interface terminal shall have downward compatibility whereby all new model designs can be interchanged with similar models to reduce obsolescence.

d. The operator interface terminal shall be designed for the following environmental parameters:

1) Operating temperature range of 0 to 55 ºC (32 to 131 ºF)

2) Non-operating temperature range of -25 to +70 ºC (-13 to 158 ºF)

3) Humidity range of 5 to 95% non-condensing

e. The operator interface terminal shall operate on power input of 18 to 32 VDC isolated. For DC applications using AC power, an external, remote AC-to-DC power supply shall be available for DIN-rail mounting.

f. The operator interface terminal shall be provided with clamps for installing the display in the enclosure's cutout. The clamps shall compress the bezel gasket to form a permanent seal against the panel.

g. The operator interface terminal shall be designed to provide free air flow convection cooling without a fan

4. Display Features:

a. The operator interface terminal shall have:

1) Flat panel display with Active Matrix Thin Film Transistor (TFT) color

2) Backlight (not replaceable)

b. Touch screen operator interface terminals shall have the entire screen available for object usage.

c. The operator interface terminal shall be configured to run an open or closed desktop environment:

1) An open system launches the Windows Explorer shell on start-up and appears with the Windows desktop and control panel. The system is configurable via the control panel and supports Windows operations.

2) A closed system launches an application on start-up and does not allow access to the Windows desktop.

5. Logic Features:

a. The operator interface terminal memory shall have a minimum total capacity of:

1) 512 MB of solid-state (Flash) memory that is non-volatile and houses the operating system, user applications, and log files

2) 512 MB of RAM memory that processes any active application program

b. The back of the operator interface terminal shall have a slot for a Secure Digital (SD) memory card for loading the application, for upgrading firmware and for backing up, restoring, and cloning system images. The operator terminal shall operate with the memory card removed.

c. The operator interface terminal shall have one Universal Serial Bus (USB) type-A connector port to connect to:

1) HID, USB keyboard, and USB mouse devices with native device drivers

2) Removable, hot-swappable USB flash drives for external storage

3) Other USB devices such as modems, cameras, and bar-code readers

d. The operator interface terminal shall have a Back Up and Restore Utility which allows creation of a clone image of the terminal's configuration, including firmware, application, and network settings. This cloned file can be put on a USB Flash Drive or SD Card, allowing complete restoration of a replacement terminal without the need for a computer or software.

e. The operator interface terminal's communication shall be EtherNet/IP.

f. The operator interface terminal shall include a battery-backed real-time clock.

1) Access to the time and date shall be from the user program.

2) Message generation and alarm generation shall be time-stamped.

g. The operator interface terminal shall include indicators for the following:

1) CPU status information

2) Communications status information for the logic module channel

h. The operator interface terminal shall interface with a single programmable logic controller as addressed in this Section or as indicated on the Contract Drawings.

6. Programming:

a. The programming software shall be:

1) Compatible with the logic controller programming software

2) Compatible with communications systems driver software

3) Tested to run on Microsoft Windows latest version.

b. A single programming package shall be capable of programming the family of specified graphical operator interfaces.

c. A configuration mode on the operator interface terminal shall be provided to adjust display characteristics, memory card (if used), terminal presets, terminal information, date and time, and printer setup on demand, and be available from run mode if required.

d. Run mode object shall be available to place the operator interface terminal in Run mode on demand from the configuration mode.

e. The software package shall serve the following minimum operator devices:

1) Pushbuttons and selectors

2) ASCII entry devices

3) Diagnostic indicators

4) Message displays

5) Embedded numeric and ASCII variable displays

6) Analog and digital gauges

7) Trends

8) Animation of objects

f. The software package shall offer such features as cut, copy, paste, and tag import/export capabilities in and between various HMI application files.

g. The operator interface terminal shall be capable of displaying the following data types:

1)	Bit	0 or 1
2)	4BCD:	0 to 9999
3)	Unsigned Integer	0 to 65535

4)	Signed Integer	-32768 to +32767
5)	DINT	-2,147,483,648 to 2,147,483,647
6)	SINT	-128 to +127
7)	IEEE Floating Point	to single precision
8)	String	82 characters
9)	Boolean	True or False

7. Programming Techniques

   a. The programming format shall involve placing input and output objects via the offline programming and configuration package:

      1) Up to 25 displays

      2) Up to 200 alarm messages

      3) Maximum 1 controller connection

   b. Input and output objects shall be linked to the logic controller via “tags” that contain addressing information to access the data in the logic controller.

   c. Capability shall exist for the following:

      1) Trending/data logging

      2) Recipe management

      3) Macros

      4) Graphics library to include various industry objects such as motors, pumps, pipes, etc.

      5) Graphic animation

      6) Go online and then download the application to the operator interface terminal

   d. The operator interface terminal software shall be compatible with pre-programmed and pre-tested graphics (Faceplates) and associated programmable controller code (Add-on- Instructions), which include device configuration, commissioning, status and control, fault and alarm indication, diagnostics, and operator help. Faceplates/Add-on-Instruction sets shall be available for devices such as Variable Frequency Drives, Digital and Analog Input/Output Modules, Overload Relays, Power Monitors, and Networks.

   e. Print operation shall be initiated with a “print” object in the user application.

   f. The operator interface terminal shall feature a PDF viewer to access PDF files that are stored on the terminal.

g. New operator interface terminal firmware can be downloaded into the terminal on demand via SD card or Ethernet communications.

h. The operator interface terminal shall have a user-configurable alarm system capable of popping up an alarm banner on a user screen and presenting information that is critical to the user and of immediate use. The Alarm banner shall be configured to include the following buttons:

1) Acknowledge

2) Acknowledge All

3) Alarm Status Mode

4) Clear Alarm Banner

5) Clear Alarm History

6) Print Alarm History

7) Print Alarm Status

8) Reset Alarm Status

9) Silence

10) Sort Alarms

11) Non-volatile memory shall store the operating system information to protect against loss in case of power loss or system shutdown.

8. Ratings:

a. The operator interface terminal shall be able to withstand:

1) Vibration: 10 – 57 Hz, 0.012 peak-to-peak displacement; 57 – 500 Hz, 2 g peak acceleration

2) Altitude, Operating: 2000 m (6561 ft)

3) Shock, Operating: 15 g at 11 ms

4) Shock, Non-operating: 30 g at 11 ms

b. The operator interface terminal shall have enclosure ratings of NEMA/UL Type 12, 13, 4X (indoor use only), and IEC IP66.

D. HMI Software

1. HMI Software shall comply with Section 40 61 95 – PMCS Monitoring and Control Criteria.

2. Acceptable Product:

a. HMI/SCADA software shall be Wonderware InTouch HMI by Aveva Solutions/Schneider Electric.

E. Portable Programming Unit

1. The Contractor shall provide industrially hardened portable programming unit (PPU), one per pumping station, for use on all PLCs furnished for loading the control program into the processor memory and monitoring the data table.
2. PPU shall be Dell Latitude 7330 Extreme Rugged Laptop with the following specifications, to be upgraded to the latest model/specifications at the time of purchase:
    a. Processor: 11th Gen Intel® Core™ i7-1185G7, vPro® (12 MB cache, 4 cores, 8 threads, 3.00 GHz to 4.80 GHz Turbo).
    b. Display: 13.3" FHD 1920x1080, 60Hz, WVA, Touch, AG, 1400 nit, 100% sRGB, Outdoor-viewable, Passive Pen included.
    c. Operating System: Windows 11 Pro, English.
    d. Systems Management: Intel vPro Technology Advanced Management Features
    e. Memory: 16 GB: LPDDR4x, 4266 MT/s (onboard)
    f. Storage: 1 TB, M.2, PCIe NVMe, SSD, Class 40
    g. Camera: Mic + IR FHD camera for WWAN/WLAN antennae; Pogo vehicle docking and RF passthrough
    h. Hazardous locations certification: Required
    i. GPS: Dedicated u-blox NEO GPS Card
    j. Keyboard: English RGB backlit sealed keyboard
    k. Wireless: Intel® AX210, 2x2, 802.11ax, Bluetooth® wireless card
    l. Mobile broadband: 5G - Qualcomm® Snapdragon™ X55 Global 5G (DW5930e), eSIM, Verizon
    m. Primary battery: 3 Cell, 53.5 Whr, long-lifecycle 3-year battery
    n. Secondary battery: Additional 3 Cell, 53.5 Whr, long-lifecycle 3-year battery
    o. Security: Smartcard reader, Express card
    p. Resource Media: USB
    q. Energy Star: Qualified.
    r. Software (in addition to PMCS software): Microsoft 365, McAfee Business Protection 3-year.
    s. Accessories: Dell Pro Wireless keyboard and mouse.
3. The PPU shall be able to interface with the PLC during operation.

4. The PPU shall be furnished with the latest Windows Operating System at the time of bid, communication interfaces and a dust, drip and rain proof fully sealed case.
5. The PPU shall have comply :
   a. Section 40 61 95 – PMCS Monitoring and Control Criteria.
6. The PPU shall be capable of programming the PMCS PLCs through the use of a ladder logic instruction set.
7. It shall also be possible to observe the I/O status and the register values.
8. Overriding of inputs and outputs shall also be possible.
9. The PPU shall be capable of basic programming functions which shall include normally-open, normally-closed contacts, latch relays, one shots, timers, and up-down counters.
10. The PPU shall contain an available field of nine (9) contacts and one (1) coil across by seven (7) contacts down, for each rung of the program.
11. The PPU shall be capable of modifying the program element by element or rung by rung.
12. The PPU shall also be capable of complete program documentation.
13. The PPU shall have the following three modes of operation, on-line, off-line, and monitor.
14. The PPU shall be capable of displaying the status of contacts, coils, timers, counters, and registers while in the monitor mode.
15. The PPU shall be capable of normal programming in the off-line mode.
16. The PPU shall be capable of editing, and modifying the running program while in the on-line mode.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS PLCs, HMIs, HMI Software, and PPU shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. PMCS PLC monitoring and control criteria specified under this Section shall be functionally verified during PMCS Factory Testing.

C. PMCS PLCs, HMIs, and Software shall be factory tested after being fully assembled and configured at the factory as integral components of the following control panels:
   1. PMCS- 9110 SCADA Panel
   2. RTU-9130 Telemetry Panel

D. Witnessed Factory Acceptance Tests (WFAT) shall be performed on each PMCS control panel and its components in accordance with Section 40 80 81 – PMCS Factory Testing, paragraph 2.04, consisting of the following:

1. HMI Demonstration
2. PMCS Hardware Operational Testing
3. PMCS Software Demonstration
4. System Performance Testing
5. Demonstration of Communications between PLCs:
    a. Simulate data communication between MSPCP-1600 with BSCP-9120 and PMCS 9110.
    b. Simulate data communication between EMCS-1510 and PMCS-9110.
    c. Demonstrate actual data communication between PMCS-9110 and RTU-9130.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 IMPLEMENTATION

A. Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents.

B. Configure PLC, HMI, Software and PPU to prevent erroneous and nuisance alarms by using techniques including time delays and logic such as

1. Inhibit initiation of a seal water failure alarm when pump is not running
2. Provide a time delay on high discharge pressure alarm.

C. Arrange PLC data table. Repeat all status and alarm bits and analog values (including timer and counter presets) into a separate, contiguous block of memory, grouped by type. Provide 25% space in each group to allow for future expansion.

D. Configure operator interface unit using function keys and instructional prompts so that the operators can modify set-points and presets without any special training or knowledge of the PLC program.

E. A modular and structured approach to PLC program development shall be implemented.

F. The programs shall be broken up in logical segments to allow easy debugging in the field.

G. All real world outputs/inputs shall be grouped such that their addresses can be mapped in contiguous registers to allow use of matrix functions for troubleshooting, debugging, and alarming.

H. An alarm segment shall be developed for all real world outputs.

I. The alarm segment shall be separate from the rung logic for real world outputs.

J. For open/close valves, the associated limit switch positions shall be compared with the PLC output.

1. If the output calls for an open valve, the open limit switch should be made and the closed switch should not and vice versa.

2. Any combination other than these two shall cause an alarm.

K. The PLC shall monitor limit switch positions for valves in transition.

1. Valves in transition (between open and close position) shall be displayed on the operator interface with message "In Transition".

2. The Contractor shall submit limit switch development for all valves.

L. For motors, the run output shall be compared to the run status with the appropriate time delays.

1. Any mismatch between RUN output and RUN status shall cause an alarm.

M. Unless waived in writing by the engineer, application programs written for PLCs shall be written using ladder logic, showing discrete references in individual ladder rungs.

N. Each output shall have its own complete set of logic to aid in startup and trouble shooting.

O. Where duplicate or repetitive logic is required subroutines shall be used to reduce program memory requirements and scan time.

P. The program shall be written in a logical sequence with associated rungs grouped together in a manner to make the system logic clearly evident.

Q. Where multiple rungs use the same constants for associated presets or reference, the constant shall be in the form of a register location and shall be loaded in the beginning of the program each time it is run.

R. All preset register values shall be part of the program and load each time the program is run.

S. Where possible, constants that must be calculated shall have this done in the program.

T. Where values must be input, whether in the program or during operation, software "traps" shall be used to prevent input of values out of range or that will cause improper operation of the system.

3.03 FIELD TESTING / QUALITY CONTROL

A. PMCS PLCs filed testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. PMCS PLCs monitoring and control criteria specified under this Section shall be verified during PMCS Startup and Field Testing.

C. [Define specific field tests requirements for PMCS PLCs here]

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the correct implementation of the PMCS PLCs specified under this Section.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SECTION 40 67 16 – PMCS PANELS AND ENCLOSURES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, supervision, materials, equipment and incidentals as shown, as specified and required to furnish, install, calibrate, test, start-up and place into satisfactory operation all control panels and/or equipment enclosures, termination cabinets and all associated equipment, as indicated on the Contract Drawings and as specified in this Section.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	2
1.09	Spare Parts, Special Tools, and Supplies	2
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	17
PART 3	EXECUTION	18
3.01	Examination / Preparation	18
3.02	Installation	18
3.03	Field Testing / Quality Control	19
3.04	Startup / Demonstration	19
3.05	Adjusting / Protection / Cleanup	20

C. A schedule of system panels is provided in Attachment A at the end of this Section, for the convenience of the Contractor. The schedule may not indicate all panels and does not indicate all enclosures required for this Contract. The Contractor shall furnish and install all panels and enclosures as required.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete.

B. Section 05 05 23.02 – Miscellaneous Metal Fastenings.

C. Section 26 43 13 – Low-Voltage Surge Protective Devices

D. Section 31 23 16 – Excavation.

E. Section 31 23 23 – Fill.

F. Section 40 61 13 – PMCS General Requirements.

G. Section 40 80 81 – PMCS Factory Testing

H. Section 40 80 82 – PMCS Startup and Field Testing

1.04 REFERENCES

A. Definitions

1. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts for the equipment provided under this Section.

B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, provided with labels clearly designating the manufacturer's part number with complete information for use and reordering.

C. The Contractor shall provide minimum the following:

1. Ten (10) percent (minimum of 1), spare space heaters of each type and rating.
2. Ten (10) percent (minimum of 1), spare heater thermostats of each type
3. One (1) spare lighting fixture and switch of each type provided.
4. Ten (10) percent (minimum of 2), spare power supply, regulator, power conditioner, etc., of each type and rating provided.
5. Ten (10) percent (minimum of 1), spare thermal control device (fan, air conditioner, heat exchanger, etc.) for each type and rating provided.
6. Ten (10) percent (minimum of 10), spare fuses, circuit breakers, equipment mounting (DIN) rails.
7. Twenty-five (25) percent (minimum of 100) spare terminals of each type provided for the entire project.
8. Spare parts as recommended by the individual equipment manufacturers.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. NEMA 4, 4X and 12 panels and enclosures shall be as manufactured by:
   1. Hoffman, Anoka, MN;
   2. B-Line, Highland, IL;
   3. Or approved equal.

B. NEMA 7 panels and enclosures shall be as manufactured by:
   1. Adalet, Cardington, OH;
   2. Crouse-Hinds, Syracuse, NY;
   3. Or approved equal.

C. Fiberglass or polycarbonate panels and enclosures shall be as manufactured by:
   1. Adalet, Cardington, OH;
   2. Crouse-Hinds, Syracuse, NY;
   3. Or approved equal.

D. Wire troughs and wire management shall be as manufactured by

1. Panduit, Lockport, IL;
2. Or approved equal.

E. Circuit breakers shall be as manufactured by:

1. Siemens Industry, Inc., Washington, DC;
2. Allen Bradley (Cat No 1492, 1492-GH);
3. Or approved equal.
4. Or approved equal.

F. Terminal blocks shall be as manufactured by:

1. Entrelec, Montgomery AL;
2. Or approved equal.

G. Fused Terminal blocks shall be as manufactured by:

1. Allen-Bradley;
2. Phoenix Contact, Middletown, PA;
3. Or approved equal.

H. Panel or enclosure heaters shall be as manufactured by:

1. Hoffman (DAH8001B), Anoka, MN;
2. Or approved equal.

I. Panel or enclosure corrosion inhibitors shall be as manufactured by:

1. Hoffman (HCI series), Anoka, MN;
2. Or approved equal.

J. Panel or enclosure heat exchangers shall be as manufactured by:

1. Hoffman (Spectracool), Anoka, MN;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General Requirements:

1. Furnish and install panels, boxes and enclosures with a NEMA rating based on the table listed in Appendix A in this Section.
2. Panels and enclosures shall meet or exceed the NEMA and NYCEC requirements for the area in which they are installed.

3. Unless otherwise specified or indicated, panels and enclosures shall have a NEMA 4X rating and shall be fabricated of Type 316 stainless steel.

4. Panels provided as part of a packaged system, from an equipment vendor, (sump pumps, seal water pumps, VFDs, etc.) shall comply with all requirements specified in this Section.

5. The NEMA rating of panels, enclosure and devices shall be as required in their individual Sections if so specified.

6. The sizes of panels and enclosures shown on the Contract Drawings are estimates.

7. The Contractor shall furnish enclosures of the size required to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing, and other components installed in the enclosures while maintaining adequate free space within the enclosure.

8. Panel, box and enclosure doors shall be continuously hinged and shall be of pan construction. Clamp type closures shall be provided.

9. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

    a. Provide sub-panels for installation of all internally mounted components.

    b. Provide mounting strips for installation of all relays and other components where mounting strips are practical.

    c. Sub-panels shall be pan construction to prevent warping.

10. Devices shall be arranged to allow adequate wiring room for ease of connections and servicing.

11. All panel and enclosure components shall be identified both inside and out with engraved, laminated plastic name plates.

12. Panels shall be provided with an engraved laminated plastic sign inscribed "WARNING – This Device Is Connected to Multiple Sources of Power ". Letters shall be 1/2" high, white on a red background

13. Provide all electrical and/or pneumatic connections, components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels complete and operational units.

14. Provide bulkhead fittings for all gas, liquid piping and tubing leaving panels and enclosures.

15. Provide all panel-mounted pilot devices as shown and specified.

16. Locate and install all devices, wiring, and components so that connections can be easily made and there is ample room for servicing each item.

17. Components for installation on panel exterior shall be located as shown on the Contract Drawings or as directed by the engineer.
    a. Layouts shall be submitted for approval.
    b. All exterior panel mounted instruments shall have a NEMA rating equal to or greater than the enclosure.
    c. For panel mounted devices which cannot be obtained with the correct NEMA rating equal to the enclosure, the device shall be mounted behind a transparent viewing window or door, manufactured for the purpose that provides the proper rating.
    d. The viewing window or door shall maintain the NEMA rating of the enclosure and be easily opened for access to the instruments.
18. Where permitted by location and layout as shown on the Contract Drawings, all panels and enclosures shall have full height rear access doors, unless otherwise shown.
19. Where rear doors are not possible, panels shall have full height front access doors.
20. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.
21. Free standing control panel, enclosure or any panel with a dimension of 36 inches or more shall comply with the following:
    a. Provide at least one 120 VAC, 15 Amp duplex, grounding type receptacle.
    b. At least one 120 VAC LED light fixture complete with a protective plastic shield and capable of generating 25 foot candles on all the components within the enclosure.
    c. One 120 VAC, 15 Amp, snap switch in an outlet box with a cover to turn on the light. The switch shall be located so that it is easily accessible from the door.
    d. The service light with switch and duplex receptacle shall have their own circuit breaker.
    e. The bottom 12 inches and top 6 inches of free-standing panels shall be free of all devices, including terminal strips, to provide ease of installation, wiring and testing.
    f. In general, panel indication and control devices shall be mounted within a range of 40 to 72 inches above the operating floor but not less than 36 inches nor greater than 78 inches unless otherwise shown on the Contract Drawings.

g. Annunciators or alarm message display devices shall be mounted up to 84 inches above the operating floor.

h. All instrument read-outs and displays shall be in ENGINEERING UNITS of the desired process variable. Percent of scale or digital counts are not acceptable unless approved in writing by the Engineer.

i. Panels shall be constructed with an integral fully enclosed solid bottom section at least 6 inches in height from the bottom of the enclosure to the bottom edge of the enclosure door opening.

j. Free standing enclosures shall be mounted on concrete base pad.

k. Free standing panels installed in areas with raised computer type floors shall be provided with an adjustable, welded steel support frame to support the panel from the building structure.

1) The frame load rating shall have a 50 percent safety factor.

2) The frame shall be coordinated with the flooring being installed and shall be flush with the height of the raised floor.

B. Panel and Enclosure Fabrication:

1. Panels and enclosures shall be fabricated as indicated on the Contract Drawings and as specified in this Section.

a. Control panels and enclosures shall be assembled, wired, and tested in the PMCS Supplier's own or other City/Engineer approved facility.

b. All components and all necessary accessories such as power supplies, power conditioning equipment, mounting hardware, input and output terminal blocks, plug strips, relays, lighting, circuit breakers, fuses, and other components which may be required to complete the system shall be provided.

c. The Contractor is directed to review the area classifications with regards to hazardous atmospheres, as they are defined by the NYCEC and NFPA 820.

1) Many areas of the facility within the scope of this Contract are classified as NYCEC Class I, Division I or II hazardous and all construction shall meet those requirements.

2) All equipment, controls, instruments, panels, enclosures, etc., for use in these areas, shall be constructed to meet the area requirements.

d. All control panels and enclosures shall be of formed or welded construction of steel or stainless steel, as required, unless otherwise noted.

e. Panels and enclosures shall be fabricated in accordance with the NEMA ratings as specified, shown, or required.

f. Panels and enclosures shall meet or exceed the requirements of the area in which they are located.

g. As a minimum, a NEMA 12 rating shall be required in all non-corrosive areas and NEMA 4X S/S in outdoor, process, and corrosive areas

h. Where enclosure size or weight requires, provide lifting eye bolts to facilitate handling of the enclosures.

   1) All panels or enclosures with any dimension 72 inches or greater or with a weight in excess of 150 pounds, shall be equipped with lifting eyes.

   2) Bolt lifting eyes directly through the enclosure structural members.

i. Continuously weld all exterior seams and grind smooth.

j. Reinforce sheet steel with steel angles where necessary to adequately support equipment, ensure rigidity, and preclude distortion and resonant vibrations.

k. Panels and enclosure surfaces shall be flat within 1/16 inch over a 24 inch by 24-inch area, or flat within 1/8 inch for a larger surfaces.

   1) Flatness shall be checked by using a 72-inch-long straight edge.

   2) Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.

l. Use pan-type construction for doors.

   1) Door widths shall not exceed 36 inches.

   2) Mount doors with full-length heavy-duty continuous piano hinge with stainless steel hinge pins.

   3) Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.

   4) Provide oil resistant continuous gasket completely around each door or opening.

m. Provide interior mounting panels and shelves constructed of minimum 12-gauge steel with a white enamel finish.

n. Provide steel print pocket with white enamel finish.

o. Use 304 stainless steel fasteners throughout.

p. Provide Type 316 stainless steel sun shielding for all outdoor panels.

q. Panels and enclosures shall have adequate wiring space provided on the top and bottom.

1) A minimum of six (6) inches of clear space shall be provided between enclosed equipment and the top and the bottom of the enclosure.

2) Additional space shall be provided when a large number of conduits or wires enter the enclosure.

r. Provide enclosure mounting supports or bases as required for floor, frame, or wall mounted enclosures, and for free standing enclosures.

1) For floor mounted enclosures, provide minimum 12-gauge stainless steel floor stand kits bolted to the bottom of the enclosure, sealed and gasketed to maintain the NEMA rating.

2) Floor stand heights shall be coordinated with enclosure sizes and base pads to comply with the general indication and control device mounting height requirements as specified in this Section or as shown on the Contract Drawings.

3) Floor stands shall be mounted on base pads using anchor bolts or expansion anchors.

s. All panels shall have solid bottoms.

1) Removable panels may be provided to ease punching of conduit entries.

2) Panels and enclosures mounted on raised floors may have open bottoms but shall comply with all codes.

t. Provide all necessary holes and cutouts for installation of equipment.

1) Openings shall be punched or saw cut without distorting the face of the panel.

2) Flame cutting is prohibited.

3) All openings shall be ground straight, square, level and smooth.

u. Provide space and clear area for entry of conduit and wire.

v. Cable and piping shall enter the enclosure through the bottom whenever possible.

w. All conduit and piping openings and all conduits shall be sealed watertight and maintain the NEMA rating of the panel.

x. Panels located inside air-conditioned control room areas shall be NEMA 12 rated stainless steel unless otherwise noted.

y. Fabricate enclosures using minimum 14-gauge stainless steel for wall or frame-mounted enclosures and minimum 12-gauge stainless steel for floor mounted and free standing enclosures. Steel shall be free of pitting and surface blemishes.

z. Standard prefabricated enclosures are preferred.

aa. When required by area classification or Contract Documents, NEMA 7 panels and devices shall be provided.

1) Panels and enclosures, to be installed in areas classified as hazardous (Class I, Div. I or II), per Contract Documents or Codes, shall be constructed to NEMA 7 and Class I, Division I, Group D requirements.

2) In damp or corrosive areas, these panels shall have an "O" ring seal on the door, to prevent entry of corrosive atmospheres.

3) These panels shall be manufactured with all necessary tapped openings to accept devices and conduit entry.

4) Ten (10) percent (minimum of one (1) spare, plugged, tapped, openings shall be provided for each size furnished.

5) Field tapping is not permitted.

C. Environmental Controls

1. Outdoor Panels:

a. Provide thermostatically controlled heaters to maintain temperature inside each enclosure 10°F above the ambient temperature, above 40°F., or that required for component operation (whichever is greater), and to prevent interior condensation over an outside ambient temperature range of -20°F through 120°F.

b. Provide automatically controlled closed-loop heat exchangers or closed loop air conditioners with filtered air louvers when required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.

c. Provide internal corrosion inhibitor devices for corrosion control inside of each enclosure.

d. Outdoor panels shall be designed to withstand wind driven rain and snow without any moisture entry. The panel shall not be damaged by the buildup of ice or snow.

D. Indoor Panels:

1. Provide automatically controlled heaters as required to maintain temperature approximately 10°F above ambient for condensation prevention inside panels.

a. Panel heaters shall be thermostatically controlled, fan-driven heaters, with all components mounted in an anodized aluminum housing for sub-panel mounting.

b. The heaters shall be powered from 115 VAC from a dedicated circuit breaker and separate panel power feed.

2. Provide automatically controlled closed loop heat exchangers or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.

a. Heat exchangers and air conditioners shall be of a dual loop design to isolate panel interior air from exterior air.

b. The units shall be thermostatically controlled and shall be powered at 115 VAC from a dedicated circuit breaker and separate panel power feed.

E. Electrical

1. General:

a. Control panel power supply source type, voltage, number of circuits and circuit ratings shall be as shown on the Contract Drawings and as required by the equipment.

b. Unless otherwise noted, power supply to all panels shall be 120VAC 60 Hz.

c. Surge and lightning protection shall be provided for all electronic equipment. Surge and lightning protection shall comply with the requirements of Section 26 43 13 – Low-Voltage Surge Protective Devices.

d. Uninterruptible Power Supply (UPS) units shall be provided to supply power to control panels as indicated on the Contract Drawings.

1) As a minimum, a UPS shall be provided for all panels and enclosures containing network, PLC, gas detection, etc. equipment. UPS units shall be furnished and installed as specified.

2) The UPS will power the PLC, communications equipment, and 24VDC power supplies.

3) UPS shall be sized to provide backup power to powered loads for 30 minutes upon loss of utility power.

e. The panels and enclosures shall be provided with internal 120 VAC, 20-amp DIN rail mounted circuit breakers sized as required to distribute power to the panel components and field instruments.

f. Provide quantity of circuits shall include 25 percent spares.

g. Provide a durable legend mounted near the circuit breakers in each panel, which lists the circuit breaker numbers and circuit descriptions.

h. Provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.

i. Redundant PLC-monitored 24VDC power supply system shall be provided in each control panel to power all process transmitter/indicators, 4-20mA based instrument loops as well as all PLC based discrete input.

j. DC power supply system in each control panel shall consist of the following:

1) Two DC power supply units, each sized to carry the total load plus 25% spare.

2) Two redundancy modules for consistent redundancy and continuous monitoring through the load.

3) Two electronic circuit breakers to prevent the interruption of the output voltage at the switched-mode power supply unit in the event of an error and to indicate interference.

4) Dual surge protection on the secondary side with SIL3 certification.

k. Where wires pass through adjacent panel walls, provide suitable grommets or bushings to prevent cutting or damage of insulation.

l. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies, transformers, regulators and fuses in the panel.

m. All spare field and panel wires, within each panel or enclosure, shall be tagged as spare and labeled and marked as per specifications with “As-Builts” showing their source and destination.

n. Provide complete approved schematic and wiring diagram including spare wiring, showing "As-Built" circuitry.

o. In addition to required submittals, the final approved "As-Built" diagram shall be enclosed in transparent plastic and placed in an easily accessible drawing pocket built in the panel or enclosure door.

2. Electrical Wiring and Accessories:

a. Unless otherwise specified, internal wiring shall be Type MTW stranded copper wire with thermoplastic insulation rated for 600 Volts at 85°C for single conductors.

b. Wiring shall be color coded and labeled with wire identification.

c. For DC signal wiring, use No. 16 minimum AWG twisted tinned copper pairs with overall braided copper shield and drain wire.

d. For AC power wiring, use No. 12 minimum AWG. For AC and DC control use No.14 AWG wiring. For wiring carrying 10 Amps or more, use sizes required by NYCEC.

e. Install wiring runs in ventilated wire troughs along horizontal or vertical routes to present a neat appearance.

1) Wire trough shall be filled to no more than 40 percent capacity. Angled runs are not acceptable.

2) Separate and shield DC signal wiring from power and control wiring by a minimum of 4 inches, using separate wire troughs.

3) Separate troughs shall be provided for field wiring.

4) Where practical, in the panels and enclosures, route the low voltage DC signal wiring along the left side of the enclosure sub-panel(s) and route the AC power and control wiring to the right side of the sub-panel(s), with the incoming power and distribution circuit breakers located to the upper right.

f. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size to be 1 inch. Troughs shall have 60 percent spare capacity. Adequately support and restrain all wiring runs to prevent sagging or other movement.

g. In panels controlling and monitoring equipment operating or fed at voltages above 600, wiring used for AC or DC, control, control power, metering, indication, etc. shall be No.14 AWG type SIS (switchboard) wire.

h. Wiring for current transformer (C.T.) circuits shall be minimum #10 AWG type SIS and shall be color coded yellow. Connections shall be by ring type solderless compression terminals.

i. Where wiring runs across a door or panel hinge, the bundle shall be run along the hinge as far as possible and anchored at both ends to distribute the torque along the greatest wire length.

j. Wire bundles running within a panel or onto the door, shall have at least 20 percent spare wires included.

3. Terminal Blocks:

a. Terminate all field wiring and internal panel wiring at 600 Volt barrier type terminal blocks.

b. Panel wiring shall be kept to one side of the strip leaving the other side for field wire termination.

c. Jumpers needed to provide common connections between terminals shall be provided on the panel side of the strip.

d. Terminal blocks shall be tubular screw type with pressure plate capable of accepting #22 through #8 wires and shall be mounted on rigid steel rail.

e. All wiring terminations, both field and panel shall be made with forked tongue solderless crimp type connectors. Field wiring terminals shall have a minimum of a # 8 screw or stud.

f. Heavy duty end anchors shall be provided on both ends of all terminal strips to firmly anchor the terminal blocks to the mounting rail and insulating end barriers shall be provided on one end of the terminal strip as necessary.

g. Terminal blocks shall have a unique identifier for each block and for each terminal on that block (i.e. TB7-25) where the terminal number shall be the unique wire number shown on the approved drawings.

h. No more than two wires shall be terminated at any single screw.

i. Provide jumpers as required to join adjacent terminal blocks for additional wiring connection points. Jumpers shall only be installed on the panel side of the terminal block.

j. All terminal blocks shall be labeled with permanently affixed numeric identifiers on each block.

k. Identifiers shall be self-stick plastic strips with permanent, machine printed numbers.

l. Provide a separate terminal block for landing analog signal cable shield, and separate terminal strips for DC signal and AC power wiring. A separate terminal shall be provided for landing shield wiring.

m. Provide separate terminal blocks for C.T wiring. Terminal blocks for C.T. wiring shall be equipped with shorting bars and screws to selectively short an individual C.T. circuit for maintenance purposes.

n. Provide spare terminal blocks equal in number to 20 percent of the terminals used for each type of wiring (i.e., DC signal and AC power).

o. Terminal blocks shall be copper-nickel alloy terminal strips and screws.

p. Terminal blocks shall have minimum clearance of 5 inch on each side of each strip.

4. Fused Terminal Blocks:

a. Provide fused terminal blocks for all wiring powered from within panels or enclosures to devices located outside the panel or enclosure, as required.

b. Fused terminal blocks shall be UL approved, 600 Volts, capable of accepting #22 through #10 wires, and shall be mounted on rigid steel rail. Fuses shall be dead front and shall have safety pull out feature.

c. Heavy-duty end anchors shall be provided on both ends of all terminal strips to firmly anchor the terminal blocks to the mounting rail and insulating end barriers shall be provided on one end of the terminal strip as necessary.

d. Provide fuses (sized as required) and fuse pullers for all fused terminal blocks.

e. Provide 20 percent spare fused terminal blocks rail mounted within each panel or enclosure.

f. Terminal blocks shall be copper-nickel alloy terminal strips and screws.

5. Wire Markers:

a. All panel wires and field wires shall have an alphanumeric identification tag at each point of termination.

b. Wire numbers shall be unique.

c. Wire numbers shall be grouped and spaces allowed for additions to each group.

d. Where wire numbers change, the appropriate drawings shall include both wire numbers, clearly indicated, at the point of transition.

e. Each wire number shall be solid, machine printed, and not pieced from other single and/or double digit tags. Wire markers shall be heat, oil, water, tear and solvent resistant, vinyl, tube type markers.

f. All wire labels shall be clearly visible and not hidden by wire duct or other components in the enclosures. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.

6. Grounding / Bonding:

a. All equipment and components mounted in or on control panels and enclosures, shall be bonded to the equipment grounding system.

b. Provide 1-inch-wide by 1/4 inch thick copper grounding bar in each panel or enclosure containing equipment, instruments or controls.

c. The bar shall be as long as needed for the required number of connections, plus 25% future connections (6 inch minimum).

d. Ground bars shall be installed on insulated "standoffs" (1-inch clearance from grounded surfaces), and shall have a braided #6 AWG bonding jumper.

e. Separate buses shall be provided for grounding of AC equipment and for shield grounds.

f. The AC ground bus shall be bonded to the panel frame and system ground.

g. Shield grounds shall be completely isolated from the enclosure and instrument power/equipment grounds.

h. Insulated ground wires shall be run with all control power circuits within the panel to all equipment.

i. Equipment mounting sub-panels (plates) shall be bonded to the frame of the enclosure with a No. 10 AWG braided bonding jumper.

F. Finishes

1. Steel Panels

a. Panels located in control rooms, electrical equipment (switchgear, MCCs) rooms, and office areas, may be carbon steel with a finish as follows:

1) Completely clean all interior and exterior surfaces so they are free of corrosive or oily residue, oil, grease, and dirt.

2) All interior and exterior surfaces shall be phosphatized for corrosion protection for non-stainless steel enclosures.

3) One coat of primer shall be applied to all interior and exterior surfaces immediately, except for stainless steel enclosures.

4) Surfaces shall be electrostatically coated with a polyester urethane powder or epoxy powder coating.

5) Exterior surfaces shall be ANSI- 61 gray, interior surfaces shall be ANSI-61 gray or gloss white.

6) Equipment mounting sub-panels shall be given a gloss white melamine enamel coating. A Grade 1 finish shall be produced on the finish coat.

2. Stainless Steel Panels

a. Panels and enclosures located outdoors, in damp or corrosive areas, tunnels or galleries or in any process areas shall be fabricated of type 316 or 304 Stainless Steel per the manufacturers published recommendations for chemical resistance and service.

b. Stainless steel panel finish shall be brushed or satin and shall be free from blemishes and machine marks.

c. All mounting, anchoring and accessory hardware shall be stainless steel.

3. PVC Coated Panels

a. In hazardous areas, subject to frequent moisture and corrosive elements, panels shall be PVC coated.

b. In areas where the conduit and raceway system, is required to be PVC coated, all panels, control stations and enclosures shall be PVC coated. Colors shall match the conduit system.

c. PVC coating shall be a minimum of 40 Mil. and shall cover all exposed surfaces.

d. All mounting and accessory hardware shall be Type 316 stainless.

4. Panel in Highly Corrosive Areas

a. Unless otherwise noted, in areas designated as highly corrosive or where sodium hypochlorite is handled, pumped, metered or stored, panels and enclosures shall be fabricated of molded fiberglass, fiberglass reinforced polyester, or polycarbonate and recommended for the service.

b. Panels shall be finished smooth or finished with gel coat and epoxy.

c. Glass fiber strands shall be neither exposed nor visible.

d. Panels shall be chemical, sunlight and UV resistant.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop Tests

1. Shop and Testing shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used.

3.02 INSTALLATION

A. The Contractor shall install panels in conformance with NYCEC and the Contract Drawings.

B. All panels and enclosures shall be mounted straight, level and parallel to building surfaces.

C. Wall mounted panels and enclosures shall be securely mounted to walls or columns as required. They shall be spaced a minimum of 3/4" from the structure using strut or plates.

D. Stand mounted panels or stations shall be supported using 6-inch epoxy powder coated steel channel securely mounted to the floor with a minimum of three 1/2" stainless steel bolts and leveling nuts.

1. Stand bases shall be grouted for added rigidity.

2. Stands shall be secure and level, shall easily support the mounted equipment and shall hold the equipment rigidly. Multiple stands or fabricated frames shall be used for larger or heavy panels.

E. All freestanding control panels shall be installed on a 6-inch-wide and 4 inch high reinforced concrete curb or 4 inch pad.

1. Pad shall have 1-inch chamfer on all corners.

2. Pad shall extend one (1) inch minimum (plus chamfer) past panel exterior.

F. When panels or enclosures are installed on raised computer type floors, additional supports and bracing shall be provided under the floor as required to prevent the floor from being overloaded.

1. Large and/or heavy panels having any dimension larger than 36 inches or weighing 150 lbs. or more or where the weight of the completed panel exceeds 80% of the specified live load bearing capacity of the flooring, shall be supported from the structural sub floor independently of the raised floor.

2. Provide a welded steel, adjustable support framework the size of the unit footprint capable of rigidly supporting the weight of the entire panel with a 50% safety factor. The frame shall be installed flush and level with the floor.

3. Load and bracing calculations shall be submitted for review.

4. It shall be the responsibility of this Contractor to coordinate raised and finished floor installation requirements with the flooring supplier and installer.

5. In areas where floor modifications are required, and the floor has already been installed, the Contractor shall retain the services of an approved flooring contractor to make the appropriate modifications at no additional cost to DEP.

G. Panels, and the equipment enclosed, shall be protected from damage during and after installation. If in the opinion of the Contractor or the Engineer, the area is not suitable for electronic equipment or panels, the equipment shall be removed or protected until the area has been secured.

H. Unless otherwise noted, the Contractor shall install indoor panels on 4-inch concrete pad.

I. Extend concrete pad 4 inches beyond outside dimensions of the base, on all sides.

J. Lay grout after panel sills have been securely fastened down.

K. Unless otherwise noted, install outdoor NEMA 4X panels on a reinforced concrete pedestal:

1. Minimum thickness shall be 8 inches with No. 4 steel reinforcing bars at 12 inches on centers, each way.

2. Minimum size shall be 12 inches larger than outer dimensions of base, on all sides.

3. Lay grout after panel sills have been securely fastened down.

L. The Contractor shall provide excavation and backfill work in conformance with Section 31 23 16 – Excavation and Section 31 23 23 - Fill.

M. The Contractor shall provide concrete work in conformance with Section 03 30 00 – Cast-in-Place Concrete.

N. The Contractor shall install anchor bolts and anchor in accordance with Section 05 05 23.02 – Miscellaneous Metal Fastenings.

O. The Contractor shall install and interconnect all equipment, devices, electrical hardware, instrumentation and controls and process controller components into and out of and among the enclosures as indicated on the Contract Drawings.

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

ATTACHMENT A
PANEL AND ENCLOSURE SCHEDULE

Tag No.	Description	Ref. Drawing	Enclosure	Provided by
MSPCP-1600	Main Sewage Pumps Control Panel	I-101, I-103, I-104, I-105, I-106, I-109	NEMA 12	Pump Supplier
BSCP-9120	Backup System Control Panel	I-101, I-103, I-104, I-111	NEMA 12	Pump Supplier
PMCS-9110	Pumping Station Monitoring and Control System (SCADA Panel)	I-101, I-103, I-104, I-105, I-106, I-110	NEMA 12	PMCS Supplier
EMCS-1510	Electrical Monitoring and Control System	I-101	NEMA 12	MCC Supplier
GMCP-8510	Generator Monitoring and Control Panel	I-101	NEMA 12	Generator Supplier
RTM-1 and RTM-2	Real-Time Monitoring of electric energy from Con Ed Service No. 1 & No. 2	I-101	NEMA 12	DCAS
RTU-9130	Telemetry Panel	I-101, I-103, I-104, I-112	NEMA 12	PMCS Supplier
VSS-8410	Video Surveillance System	I-101, I-105, I-113	NEMA 12	VSS Supplier
LAP-120	Local Alarm Panel – Wet Well Entrance	I-103	NEMA 7, Class I, Div. 1	PMCS Supplier
LAP-140	Local Alarm Panel – Screen Chamber Entrance	I-103	NEMA 7, Class I, Div. 1	PMCS Supplier
LCS-1601A, LCS-1602A, LCS-1603A, LCS-1604A, LCS-1605A, LCS-1606A	Emergency Stop – Main Sewage Pump	I-104, I-105	NEMA 7, Class I, Div. 2	Electrical Subcontractor
LCS-1601B, LCS-1602B, LCS-1603B, LCS-1604B, LCS-1605B, LCS-1606B	Check Valve Open – Main Sewage Pump	I-104, I-105	NEMA 7, Class I, Div. 2	Electrical Subcontractor

ATTACHMENT A (Continued)
PANEL AND ENCLOSURE SCHEDULE

Tag No.	Description	Ref. Drawing	Enclosure	Provided by
LCP-7401-C LCP-7401-M LCP-7402-C LCP-7402-M LCP-7403-C LCP-7403-M	Vacuum Primer Control Panels, Vacuum Primer Starter Panels	I-106	NEMA 12	Vacuum Primer Supplier
FACP-8100	Fire Alarm Control Panel	I-107	NEMA 12	Fire Alarm/ Protection Supplier
ATC-1, ATC-2, ATC-3, AC-1	HVAC Control Panels	I-107	NEMA 12	HVAC Supplier
LCP-7791, LCP-7792, LCP-7793, LCP-7794, LCP-7795, LCP-7796, LCP-7797	Sump Pump Control Panels	I-108	NEMA 4X	Sump Pump Supplier
LCP-7901	Service Air Compressor Control Panel	I-108	NEMA 12	Air Compressor Supplier

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required to furnish, install, and test all gages, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	2
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	3
2.01	Manufacturers	3
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 05 31 – Thermoplastic Process Pipe

1.04 REFERENCES

A. Abbreviations and Acronyms:

1. w.g. Water Gauge (Water Column)

2. PTFE Polytetrafluoroethylene

B. Definitions:

1. $NaHSO_3$ Sodium bisulfite

2. NaOCl Sodium hypochlorite

C. Reference Standards:

1. ANSI/ASME B40.1 Gages, Pressure Indicating Dial Type, Elastic Element.

1.05 DESCRIPTION

A. Gages as specified herein shall include pressure, vacuum, and compound gages.

1. Pressure gages shall be designed to indicate pressures above atmospheric pressure.

2. Vacuum gages shall be designed to indicate pressures below atmospheric pressure only.

3. Compound gages shall be designed to indicate pressures above and below atmospheric pressure.

4. The scale range shall be approximately twice the normal operating pressure of the equipment or process pipe line to which the gage is connected.

B. All gauges shall be of the dial-indicating helical bourdon tube type.

C. Small gages that are integral components of specified instrument and equipment assemblies are not included in this Section.

1.06 QUALITY ASSURANCE

A. Performance Requirements:

1. Grades of accuracy shall conform to the requirement of ANSI/ASME B40.1.

a. Pressure, vacuum, and compound gages shall have an accuracy meeting Grade '2A' standards, with an error not exceeding 0.5 % of full scale range.

b. Diaphragm protected gages shall have an combined accuracy (gage and seal) of Grade 'A' standards, with an error not exceeding 1% of scale range between 25% and 75% of scale and 2%for the remainder of the scale.

2. Each gage will require that laboratory tests be certified by an independent testing agency as to accuracy.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, . submittals shall include, but not be limited to:

1. Action Submittals:
    a. Catalogs, drawings, and reference materials.
    b. Maintenance manuals.
    c. Chemical compatibility for gauges with wetted surfaces in contact with chemical solutions or gasses other than air.

B. Information Submittals:
1. Independent testing agency certification indicating that the gages provided meet the specified accuracy requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools necessary to service, disassemble, repair, and adjust the equipment provided under this Section, as per the requirements of the Contract Documents and/or as recommended by the manufacturer. In addition:
1. For gages other than diaphragm protected gages, provide 20% spare gages (with a minimum of one) of each range used.
2. For diaphragm protected gages, provide 20% percent spare gages (with a minimum of one) of each range used, complete with diaphragm seals, filled and ready for use.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gages:
1. Dial-indicating helical bourdon tube type gages shall be as manufactured by:
    a. 3D Instruments, LP, Anaheim, CA.
    b. Perma-Cal Industries, Inc., Minden, NV.
    c. Or approved equal.

B. Diaphragm Seals:

1. Diaphragm seals for diaphragm protected gages shall be as manufactured by:

   a. 3D Instruments, LP, Anaheim, CA.

   b. Ametek®, Inc., Berwyn, PA.

   c. Ashcroft, Inc., Stratford, CT.

   d. Or approved equal.

C. Accessories:

1. Brass Coil Pipe Siphons:

   a. No. 1098 as manufactured by Ashcroft, Inc., Stratford, CT.

   b. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Pressure, vacuum and compound gages shall be of the indicating dial type utilizing a Bourdon tube for confining the pressure medium.

2. Where shown, specified, or where the possibility of clogging or contaminating the Bourdon tube exists, a flexible diaphragm seal shall be provided between the Bourdon tube and the medium to be measured.

3. Dials Size: 4½-in. nominal diameter.

B. Materials and Construction:

1. Gages shall be weatherproof.

2. Gages shall be designed and constructed to meet all requirements for satisfactory operation in the environment in which they are installed. Pressure, vacuum and compound gages shall be constructed of sound, durable material free from all defects and imperfections that in any way may affect the accuracy and serviceability of the gages.

3. Case:

   a. The gage cases shall be of the blow-out protected type where the rear plate is removable.

   b. The gage cases shall be free from warpage, checks and other defects with surfaces smooth and free from chips, cracks and blisters.

   c. Gage cases shall be constructed of phenolic or high impact polypropylene.

4. Connection: ¼-in. NPT male thread.

5. Dials and Appurtenances:

a. Dials shall be white laminated plastic with standard graduations and numbers permanently marked on the dials in black.

b. Scale:

1) Scale shall extend over an arc not less than 270°.

2) Subdivisions of the scale shall conform to the requirements of ANSI/ASME B40.1 for Grade '2A' gages.

3) Units of measure shall be distinctly and permanently marked on the dial or on laminated plastic nameplates cemented to the dial.

c. Glass windows shall be ⅛-in. thick clear glass tightly seated on durable gasket material so as to be fumeproof and waterproof.

d. Bourdon tubes shall be phosphor bronze silver-soldered or brazed to its brass socket; the assembly shall be tested carefully, over-pressured and stress relieved.

e. Socket stem shall extend at least 1¼-in. below the gage case and shall have large wrench flats.

f. Movement components for geared type gages shall be of stainless steel of the rotary gear or helical roller type, constructed so as to minimize wear and meet and maintain accuracy requirements specified. Movements shall have suitable corrosion-resistant bushings and wearing surfaces.

6. Glass: Clear, blemish free, shatter-proof

7. Bourdon tube:

a. Helical Type: Inconel® X-750 or approved equal

8. Socket: Brass forging

9. Movement: Stainless steel

C. Adjustment:

1. Gages shall have provision for adjustment of the zero reading.

2. All calibration adjusting screws must be accessible from the rear without having to dismantle the gage.

D. Gage Gradations and Ranges:

1. Gages shall be graduated:

a. Pressure gages shall be graduated in psig (unless ft w.g. are shown on the Contract Drawings or specified).

b. Vacuum gages shall be graduated in inches Hg;

c. Compound gages shall be graduated in inches of Hg to 0 to psig (unless ft w.g. are shown on the Contract Drawings or specified).

2. Gage Ranges:

   a. Vacuum gages shall have scale readings of 30 inches Hg to 0.

   b. Pressure gages shall have one of the standard scale readings listed in Table 40 70 01-1, below.

Table 40 70 01-1 **Standard Pressure Gage Ranges:** **(0 to psig)**
0 to 15
0 to 30
0 to 60
0 to 100
0 to 160
0 to 300
0 to 400
0 to 600
0 to 800
0 to 1000

   c. Compound gages shall have one of the standard scale readings listed in Table 40 70 01-2, below.

Table 40 70 01-2 **Standard Vacuum & Compound Gage Ranges:** **(in. Hg to 0 to psig*)**
30 to 0
30 to 0 to 15
30 to 0 to 30
30 to 0 to 60
30 to 0 to 100
34 to 0 to 34 *

* graduated in feet of water to feet of water only

E. Diaphragm Protected Gages:

   1. General:

a. The Contractor shall provide diaphragm seals or chemical gages where shown on the Contract Drawings, specified, or required to prevent the fluid to be measured from clogging or corroding the Bourdon tube of pressure, vacuum, and/or compound gages.

b. Diaphragm seals shall be suitable for the gage furnished. Gages to be used with diaphragm seals shall be ANSI/ASME B40.1 Grade '2A' gages conforming to the requirements specified herein.

c. Chemical gages shall have the diaphragm seal as an integral part and shall conform to the applicable requirements specified herein. Overall accuracy for chemical gages shall be ANSI/ASME B40.1 Grade 'A'.

d. Diaphragm protected gages shall be factory filled and calibrated by the gage manufacturer. Diaphragm protected gages shall be provided with pulsation dampening. Integral or internal snubbers in the gage socket shall not be accepted.

e. Required Features:

1) Provide fill/bleed screw to permit filling of instrument and diaphragm seal

2) Instrument Connection: ¼-in. NPT

3) Process Connection: ½-in. NPT

4) Working Pressure Rating: Equal to or greater than the attached pressure sensing device operating pressure, or, the pipeline working pressure rating where specified, whichever is greater.

5) Flushing connection: ¼-in. NPT

6) Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.

2. Construction Materials:

a. Material Compatibility:

1) The components in contact with the fluid to be measured (i.e., the wetted materials) shall be fully compatible chemically with the fluid to be measured.

a) The material chemical compatibility shall be the highest (e.g., 'excellent', etc.) rating used by the chemical compatibility chart.

2) In the event of a conflict between the default gage materials specified in this Section and materials required to achieve the highest level of chemical compatibility (as described hereinabove), gages with materials that achieve the highest level of compatibility shall be furnished.

3) All bolts shall be corrosion-resistant to the process fluid as well.

b. Top and bottom housings, bolts, and interconnecting sensing lines shall be PVC or CPVC (as per Section 40 05 31, Thermoplastic Process Pipe) to match non-metallic piping, or as listed in Table 40 70 01-3, below.

Table 40 70 01-3
Top And Bottom Housings, Bolts, and Sensing Line Materials

Process Fluid:	Housing:	Bolts:	Lines:
$NaHSO_3$	Titanium	Titanium	Titanium
NaOCl	Titanium	Titanium	Titanium
All Other(s)	316SS	316SS	316SS

c. Diaphragms, O-rings and Gaskets shall be as listed in Table 40 70 01-4, below.

Table 40 70 01-3
Diaphragm, O-Ring, and Gasket Materials

Process Fluid:	Diaphragm:	O-Ring:	Gasket:
$NaHSO_3$	Titanium	Viton	PTFE
NaOCl	Titanium	Viton	PTFE
All Other(s)	316SS	Buna-N	Buna-S

d. Fill Fluid shall be as listed in Table 40 70 01-5, below.

Table 40 70 01-5 Fill Fluid	
Process Fluid:	**Fill Fluid:**
$NaHSO_3$	Fluorolube®
NaOCl	Fluorolube®
All Other	Silicone

F. Gage Protection:

1. Pressure gages shall have underpressure protection and vacuum gages shall have overpressure protection.

   a. For helical roller type pressure gages, the gage shall have a left-hand movement for underpressure protection; for all other gages, underpressure protection stops shall be provided.

   b. For vacuum gages with helical roller movement, gages shall have right hand movement for overpressure protection; all other gages shall have suitable overpressure protection stops.

G. Gage Accessories:

1. Pulsation Dampeners:

   a. All pressure, vacuum, and compound gages shall be provided with pulsation dampeners suitable for the intended service and environment.

2. Brass Coil Pipe Siphons:

   a. All gages on steam lines shall be provided with suitable brass coil pipe siphons to prevent live steam from entering the gages.

3. Shutoff Cocks:

   a. Gages (other than diaphragm protected gages) shall be provided with shut-off cocks furnished by the gage manufacturer.

   b. Where shown or required, three-way cocks shall be provided at gage connections.

   c. Shut-off cocks shall be suitable for the service and environment intended.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Manufacturer shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gage, switch or transmitter accuracy over the specified measurement range or at switch setpoints.

B. Diaphragm Assembly and Calibration:

1. The complete diaphragm seal assembly, including gage, switch or transmitter, shall be factory assembled, filled and calibrated to the ranges and switch setpoints specified prior to shipment.
2. Field filling shall not be accepted.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Locations:

1. Gages shall be provided where shown on the Contract Drawings, specified, and/or as required for a complete installation.
    a. Indicating Bourdon tube gages shall be provided downstream of each pressure regulating valve, on each hydro-pneumatic (air-water) or hydraulic fluid (air-oil) pressure tank, on each air and gas receiver tank, on the discharge of each air compressor and on both the suction and discharge of each pump or gas compressor.
    b. Gages shall be located in a well-illuminated area clearly visible from work areas or operating stations.
2. Location and orientation of the gages, switches and seal assemblies shall be coordinated with the actual piping and equipment installations so that gages and indicators shall be easily read during operation, and easily accessed for maintenance by plant personnel.
3. Where field mounting and orientation conflicts arise due to incomplete coordination with field changes in the process piping and equipment installation, assemblies shall be relocated, re-oriented, re-assembled and recalibrated as directed by Engineer.

B. Mounting and Connections:

1. Unless otherwise shown on the Contract Drawings or specified , pressure, vacuum, and compound gages shall have bottom ¼-in. NPT male connections.
2. Gages shall be wall, pipe, or flush mounted as shown or specified.
3. Diaphragm protected gages shall be connected to equipment as shown on the Contract Drawings, specified, or as required for an approved installation.

a. Only one pressure sensing element shall be mounted to a diaphragm seal.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 78 90 – PMCS PANEL MOUNTED INSTRUMENTS AND DEVICES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish, install calibrate, test, startup, and place into satisfactory operation PMCS Panel Mounted Instruments and Devices as described herein and as indicated on the Contract Drawings.

B. The provisions of this Section apply to instruments and devices provided as a part of packaged systems specified elsewhere in this Contract including but not limited to, function, quality, spare parts, tools, testing, training, documentation and installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	3
1.09	Spare Parts, Special Tools, and Supplies	3
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	10
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	10
3.03	Field Testing / Quality Control	10
3.04	Startup / Demonstration	11
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements

B. Section 40 63 43 – PMCS Programmable Logic Controllers

C. Section 40 67 16 – PMCS Panels and Enclosures

D. Section 40 80 82 – PMCS Startup and Field Testing

1.04 REFERENCES

A. Definitions

1. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

2. PMID - Panel Mounted Instruments and Devices.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. PMIDs and controls shall be provided with all associated services and appurtenant equipment.

B. The Contract Documents illustrate and specify general functional, environmental and construction requirements of PMIDs, and do not necessarily show or specify all components, wiring, piping and accessories required by specific manufacturers, to provide a completely integrated system.

C. The Contractor shall provide all additional components, piping, wiring, accessories, services, labor, etc. required to furnish and install PMIDs and accessories to provide a complete and properly functioning integrated system.

D. The PMCS Supplier acting through the Contractor shall:

1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation, all PMIDs specified or required under this Section.

2. Retain the services of each equipment manufacturer to properly select, apply, size and locate each PMID they are to provide.

3. Also, the manufacturer’s services shall be provided to setup, commission and fine tune all instruments provided.

4. Provide application and design engineering services to properly select, apply, and install; provide detailed design, location, and mounting drawings and to test, calibrate and commission, PMIDs provided herein.

5. Coordinate the installation of all items specified herein and required to ensure the complete and proper operation and interfacing of all the components and systems.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. All materials and equipment furnished shall be new, free from defects, and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of PMIDs.

C. Manufacturers shall have produced PMIDs for a minimum of 20 years.

D. Where there is more than one item of similar equipment required under the Contract, all such similar equipment shall be the product of one manufacturer.

E. All material furnished under this Contract shall be determined safe by UL and all material shall be labeled, certified, or listed by the testing agency.

F. Custom made equipment or related installations which are constructed specially for this Contract will not be acceptable.

G. Equipment furnished within this Contract shall be standard products furnished by a supplier regularly engaged in the manufacture of such products.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit PMIDs and schedules for the approval of the Engineer.

C. The Contractor is solely responsible for the timing of PMID submittals to enable approval by the Engineer and subsequent use by the PMCS Supplier.

D. The Contractor shall create, maintain and submit for review, an updated index of PMIDs.

E. Submittals shall be made at least 60 days in advance of any proposed use by the PMCS Supplier.

F. The manufacturer’s calculations, assumptions and application details, and recommendations shall be submitted to the Engineer for review and approval.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall comply with spare parts, special tools and supplies listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Spare parts and tools shall be as recommended by the manufacturer and shall as a minimum include the following:

1. One PMID for every five (5) PMID of a given model furnished, minimum of one.
2. One (1) communication card for every five (5) of each type furnished, minimum of one.
3. One (1) power supply for every (5) of each size furnished, minimum of one.
4. All spare parts recommended by the manufacturer and listed as recommended spare parts in the approved manufacturer's O&M Manual.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Programmable Logic Controller (PLC) shall be as manufactured by:
   1. Schneider Electric (Modicon Quantum), Andover, MA.

B. Human Machine Interface (HMI) shall be as manufactured by:
   1. Schneider Electric (Modicon Quantum), Andover, MA.;

C. Redundant DC Power Supply System shall be as manufactured by:
   1. Phoenix Contact USA, Middletown, PA;
   2. Allen-Bradley/Rockwell Automation, Milwaukee, WI;
   3. Or approved equal.

D. Uninterruptible Power Supply (UPS) shall be as manufactured by:
   1. Phoenix Contact USA, Middletown, PA;
   2. Allen-Bradley/Rockwell Automation, Milwaukee, WI;
   3. Or approved equal.

E. Signal Loop Isolators shall be as manufactured by:
   1. Moore Industries, North Hill, CA;
   2. Acromag Inc., Wixom, MI;
   3. Or approved equal.

F. Control Relays shall be as manufactured by:
   1. Idec, East Dundee, IL;

2. Square D, Andover, MA;
3. Allen-Bradley, Milwaukee, WI;
4. Siemens, Washington, DC;
5. Or approved equal.

G. Control Panel Pilot Devices shall be as manufactured by:

1. Allen-Bradley, Milwaukee, WI;
2. Square D, Andover, MA;
3. Siemens, Washington, DC;
4. Or approved equal.

H. Chart Recorder shall be as manufactured by:

1. Eurotherm Chessell Ashburn, VA;
2. Honeywell, model dr4300;
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Programmable Logic Controllers: Refer to Section 40 63 43 – PMCS Programmable Logic Controllers.

B. Human Machine Interface: Refer to Section 40 63 43 – PMCS Programmable Logic Controllers.

C. Uninterruptible Power Supply (UPS) in each control panel shall be in accordance with Section 40 67 16 – PMCS Panels and Enclosures.

D. Redundant DC power supply system in each control panel shall be in accordance with Section 40 67 16 – PMCS Panels and Enclosures.

E. Signal Loop Isolator

1. Design:

a. Provide the necessary quantity to perform all monitoring and control functions as specified and shown on the Contract Drawing.

b. Type: Isolator type signal converter/transmitter/transducer that accepts any standard or many non-standard input signals and produces a 4-20 mA output or another standard process current or voltage signal with three-way isolation (power, signal input, and signal output all isolated from each other).

2. Construction and Required Features:

a. Span Adjustment: 22-turn front panel potentiometer.

b. Zero Adjustment: 22-turn front panel potentiometer.

c. Housing: General purpose enclosure designed for internal panel mounting.

d. Power Supply Input: 117 VAC, 50/60 Hz.

e. Interference Protection: Built-in RFI/EMI protection.

3. Performance Requirements:

a. Calibration Capability: 0.2 percent of span.

b. Ambient Temperature:

1) Range: + 32 F to +158 F.

2) Effect: ± 0.02 percent per Deg F over the entire range.

c. Frequency Response: 5 Hz.

d. Input Current: 4-20 mA into 50 Ohms nominal.

e. Input Voltage: 1-5 Volts.

f. Output Current: 4-20 mA into 0-1200 Ohm load.

g. Output Voltage: 1-5 VDC at 0.25 mA DC max.

h. Span Adjustment: 100 percent ± 25 percent of span, with full scale input.

i. Zero Adjustment: 0 percent ± 10 percent of span, with minimum input.

j. Load Effect: ± 0.02 percent of the span from 0 to maximum load resistance.

F. Control Relay (General Purpose)

1. Design:

a. Type: General purpose, plug-in type rated for continuous duty.

2. Construction Features:

a. Coil Voltage: 24 VDC or 120 VAC as required.

b. Contact Configuration: Number and arrangement as required to perform the intended functions, plus a minimum of one spare SPDT contact per relay function.

c. Contact Material and Rating:

1) General Use: Silver or silver cadmium oxide contacts rated for 10 Amps minimum at 120 VAC.

2) Low Power Switching: Fine silver, gold flashed contacts specifically designed for low power switching, rated for 2 Amps minimum at 30 VDC.

d. Mounting: Pin or blade mount in sockets for sub-panel mounting on DIN rail. Sockets shall have screw terminals for wiring connections, which shall accept a minimum of two #14 AWG wires.

e. Cover: Clear plastic dust cover.

f. Indication: Indicator light.

g. Accessories: Hold-down spring, push-button test.

h. Approvals: UL recognized.

3. Loop Power Supply (Single Loop)

4. Design:

a. Provide DC power for 4-20 mA current loops and as shown on the Contract Drawing.

b. Type: A single output, regulated, plug-in type 24 VDC power supply.

5. Construction Features:

a. Housing: All components shall be enclosed.

b. Mounting: Power supply to plug into the octagonal socket with numbered, screw-type terminals. Provide mounting bracket to secure power supply module in the octagonal base.

6. Performance:

a. Temperature: Operational from -10 to 65 C.

b. Output: 24 VDC, 200 mA.

c. Power Requirements: 120 VAC, 60 Hz, single phase.

d. Regulations: ±0.5 percent.

e. Ripple: 0.5 mV RMS.

f. Protection: Overvoltage protection.

g. Approval: U.L. recognized.

G. Control Panel Pilot Devices

1. Design:

a. Provide selector switches, pushbuttons and indicating lights as specified and shown. All components shall be of the full size, heavy-duty, oil-tight, round type, with modular contacts and NEMA rating equal to that of the enclosure on which devices are installed.

b. Provide individual legend plates for indication of switch, push-button, and light functions (e.g. Open, Closed, Hand-Off-Auto). Legend plates shall conform to the requirements of this Section.

c. Start pushbuttons shall have a flush button, while stop pushbuttons shall have raised pushbuttons.

d. Where noted on the Contract Drawing, pushbuttons and selector switches shall be illuminated type and use the color code as shown.

e. Units shall be Heavy Duty, 30.5 mm, oil tight, and shall maintain the NEMA rating of the panel or enclosure. Corrosion resistant devices shall be provided on NEMA 4 and 4X panels and enclosures.

f. Extra-large, engraved, laminated name plates and function indicator escutcheon.

2. Construction Features:

a. Selector Switch:

1) Two (2), three (3), four (4) or other number of positions as shown and required.

2) Maintained or spring return position; maintained contacts; number and arrangement as required to perform intended functions specified but not less than one double pole, double throw, double break contact per switch. Contact rating shall be compatible with AC or DC throughput current of devices simultaneously operated by the switch contacts but not less than 10 Amperes resistive at 120 Volts AC or DC continuous.

3) Heavy Duty, gloved hand operator, extra-large, engraved position indicator.

b. Push-button:

1) Maintained or momentary as required and as shown on the Contract Drawing.

2) Contacts shall comply with requirements specified for selector switches above.

3) Provide extended head push-button for all stop functions, two inch-push/pull the mushroom head and maintained contacts for emergency stop functions, and flush head pushbuttons for all other functions. Emergency stop push buttons shall have padlock attachment.

c. Indicating Lights:

1) Integral transformer type.

2) Low voltage, long life L.E.D. lamps (6 Volts).

3) 0.6 Watts maximum.

4) Integral push-to-test required.

5) Lenses colors shall be as follows:

a) Run or Open: Red

b) Off or Closed: Green

c) Fault: Yellow

H. Hourmeter

1. Type:

a. Electromechanical

2. Physical

a. 7 Figures (99999.99) 0.14” Tall

b. Non-Resettable

c. Mounting Clip or Mounting Holes

d. Termination: ¼” Spade Terminals with Screws

e. Case Material: Black Polymer

f. Display Shape: Rectangular

g. Display Dimensions: 1.45” X 0.95”

h. Power:

1) Voltage: 24, 115 or 230VAC (+/-10%)

2) Power: 2 W

i. Environmental:

1) Front Panel Rating: IP65

2) Operating Temperature: -22°F to 180°F

3) Storage Temperature: -40°F to 185°F

4) Vibration: 1G [10/500HZ] IEC 68-T2-34

5) Shock: 30G [16ms] IEC 68-T2-27, 25g [16MS] IEC 68-T2-19

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS PMIDs shall confirm to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. PMCS OITs PLC monitoring and control criteria specified under this Section shall be functionally verified during PMCS Factory Testing.

C. Factory tests for PMCS PMIDs shall be performed as part of the panel assembly factory tests in accordance with standard procedures of the manufacturers.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Contractor shall install each PMID in accordance with manufacturer's recommendations, this Section and the Contract Documents.

B. Panels into which these PMIDs are to be mounted shall provide rigid structural support for the PMIDs and shall allow necessary access and working space to permit maintenance of the PMID while installed.

C. Additional strengthening and/or bracing required for a sound installation shall be provided as part of this Contract.

D. Contractor shall provide all supports, bracing, wiring, and incidental hardware.

E. All software required for the PMIDs shall be loaded, configured and fully tested as part of this Contract.

F. Contractor shall configure the OITs using function keys and instructional prompts so that operators can operate equipment, modify set points and presets and monitor the system without any special training or knowledge of the PMIDs with which the OIT interfaces.

3.03 FIELD TESTING / QUALITY CONTROL

A. PMIDs Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. Section 40 80 82 - PMCS Startup and Field Testing details how PMIDs specified under this Section shall be verified during Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the correct functioning of all PMIDs.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 79 91 – PMCS FIELD INSTRUMENTS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall retain the PMCS Supplier to provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish, install calibrate, test, adjust, startup, and place into satisfactory operation PMCS Field Mounted Instruments and Devices as described herein and as indicated on the Contract Drawings.

B. The provisions of this Section apply to PMCS Field Mounted Instruments and Devices provided as a part of packaged systems specified elsewhere in this Contract including but not limited to, function, quality, spare parts, tools, testing, training, documentation and installation.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	9
2.03	Fabrication / Assembling / Finishes	23
2.04	Source Quality Control / Shop Tests	23
PART 3	EXECUTION	24
3.01	Examination / Preparation	24
3.02	Installation	24
3.03	Field Testing / Quality Control	25
3.04	Startup / Demonstration	26
3.05	Adjusting / Protection / Cleanup	27

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 67 16 – PMCS Panels and Enclosures

C. Section 40 80 81 – PMCS Factory Testing

D. Section 40 80 82 - PMCS Startup and Field Testing

1.04 REFERENCES

A. Definitions

1. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS

2. FMID Field Mounted Instrument and Devices, including all field mounted primary sensors and transmitters.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. FMIDs and controls shall be provided with all associated services and accessory equipment.

B. The Contract Documents illustrate and specify general functional, environmental and construction requirements of FMIDs, and do not necessarily show or specify all components, wiring, piping and accessories required by specific FMIDs or specific manufacturers, to provide a completely integrated system.

C. The Contractor shall provide all additional components, piping, wiring, accessories, services, labor, etc. required to furnish and install FMIDs and accessories to provide a complete and properly functioning integrated system.

D. The PMCS Supplier acting through the Contractor shall:

1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation, all FMIDs specified or required under this Section.

2. Retain the services of each equipment manufacturer to properly select, apply, size and locate each FMID they are to provide.

3. Retain the manufacturer’s services to setup, commission and fine tune all FMIDs provided.

4. Provide application and design, engineering and services to properly select, apply, and install, provide detailed design, location, and mounting drawings and to test, calibrate and commission, FMIDs provided herein.

5. Coordinate the installation of all items specified herein and required to ensure the complete and proper operation and interfacing of all the components and systems.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. All materials and equipment furnished shall be new, free from defects, and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of FMIDs.

C. Manufacturers

1. FMIDs of the named manufacturers shall be furnished.

2. Or equal FMIDS shall be approved by the Engineer before being furnished.

3. FMIDs that are specified in this Section have been selected to establish the standard of quality and performance of the equipment to be supplied.

4. Manufacturers shall have produced the required FMIDs for a minimum of 10 years

5. Where there is more than one item of similar equipment required under the Contract, all such similar equipment shall be the product of one manufacturer.

D. All FMIDs furnished under this Section shall UL listed.

E. Custom made equipment or related installation which are constructed specially for this Contract will not be acceptable.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit FMIDs and schedules for the approval of the Engineer.

C. The Contractor is solely responsible for the timing of FMID submittals to enable approval by the Engineer and subsequent use by the PMCS Supplier.

D. The Contractor shall create, maintain and submit for review, an updated index of FMIDs.

E. Submittals shall be made at least 60 days in advance of any proposed use by the PMCS Supplier.

F. The manufacturer’s calculations, assumptions and application details, and recommendations shall be submitted to the Engineer for review and approval.

G. Reports

1. A Factory Certified Calibration certificate shall be furnished for each FMID furnished under this Contract.

    a. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit 3 copies to the Engineer of the detailed description of the installation tests to be conducted to demonstrate the correct operation of the FMIDs supplied under this Section.

    b. The Contractor shall submit proposal calibration sheets for various types of instruments for the Engineer's approval prior to the start of calibration.

    c. Calibration sheets shall include but be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.

H. O & M Manuals

1. O&M Manuals shall be submitted for each FMID

2. O&M Manuals shall comply with Section 40 61 13 – PMCS General Requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall comply with spare parts, special tools and supplies listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Spare Parts

1. The Contractor shall furnish and deliver the spare parts and test equipment as outlined below.

2. Spare parts shall be identical and directly interchangeable with similar parts of FMIDS furnished under this Section.

3. Spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

4. Spare parts and tools shall be as recommended by the manufacturer and shall as a minimum include the following:

a. One FMID for every five (5) FMID of a given model furnished, minimum of one.

b. One (1) communication card for every five (5) of each type furnished, minimum of one.

c. One (1) power supply for every (5) of each size furnished, minimum of one.

d. All spare parts recommended by manufacturer and listed as recommended spare parts in the manufacturer's submitted O&M Manual.

C. Special Tools

1. Special tools, other than those normally found in a Service Technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any FMIDs, for service and maintenance shall be provided.

2. Tools and test equipment shall be provided, together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking FMIDs under this Contract.

3. The following test equipment shall also be provided:

a. Portable Calibrators

1) Furnish Two (2) of Portable calibrators capable of measuring DC volts, mV, mA, ohms,frequency, T/C, RTD, peak detect and trip detect on its input and simultaneously generate on its output all of the preceding signals plus two-wire simulation, ramp functions, up/down stepping and 10 point programmability.

2) Each calibrator shall be furnished complete with 24 VDC integral battery pack 120 VAC power adapter, spare battery pack, test leads, external charger, fuse pack, carrying case and appurtenances.

3) Basic accuracy for DC voltages and currents shall be

a) Resistance: ±0.025%

b) Input: ±0.035%; Output: ±0.05%

c) Frequency:±0.01%.

d) Two (2) portable calibrators shall be furnished.

e) NIST traceable Certificates of Calibration shall be furnished for all calibrators.

4) Portable Calibrators shall be Rochester Instrument System Accupro Diamond or approved equal.

b. Portable Gage and Differential Pressure Calibrator

1) Furnish one portable microprocessor-based, with 8K of memory gage and differential pressure calibration system.

2) The calibration system shall include the following items:

a) Integral 115 VAC/DC battery power supply with charger, battery indicator and two sets of NI-CAD batteries

b) Two (2) Pump modules each with coarse and fine adjustment with the following ranges;

(1) 0-100 psig max air type

(2) 0-500 psi max hydraulic type

c) Four pressure modules with the following ranges capabilities

(1) 0-10 inches WC

(2) 0-30 psi

(3) 0-100 psi

(4) 0-300 psi).

3) All accessories, including manuals, tubing connectors and appurtenances shall be furnished for the unit, complete with weather resistant carrying case.

4) Portable Gage and Differential Pressure Calibrator shall be BETA Model 320 (Dual Sensor) or approved equal

c. Multimeter

1) One (1) Portable digital multimeter (DMM) with rechargeable battery and test leads, and carrying case.

2) Meter shall be furnished with NIST Traceable certificate of calibration

3) Multimeter shall be Fluke Model 8060A or approved equal

d. Hand Tools

1) A complete set of standard hand tools shall be furnished with the equipment.

2) The set shall include approximately 100 tools and shall be supplied in a durable aluminum case.

3) Tool set shall be Jensen Model JTK-17 or approved equal.

e. Portable Gas Detector

1) Four-gas detector:

a) Combustible gas or Methane (CH4): 0-100% LEL

b) Hydrogen Sulfide (H2S) 0-30 ppm

c) Carbon Monoxide (CO): 0-300 ppm

d) Oxygen (O2): 0-20% volume.

2) Event log storage: Battery operated (12 hours); Audible and visual alarms; Operating Temperature 32ºF to 104ºF.

3) DOD Technologies, Model XA-4000II, or approved equal.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Submersible Level Transducers shall be as manufactured by:

1. Noshok, Inc., Berea, OH;
2. Ashcroft, Stratford, CT;
3. Or approved equal.

B. Level Switch Float Type shall be as manufactured by:

1. Ametek Magnetrol, Aurora, IL;
2. Dwyer Instruments, Michigan City, IN;
3. Or approved equal.

C. Magnetic or Electromagnetic Flowmeters shall be as manufactured by:

1. Rosemount Analytical, Chanhassen, MN;
2. Foxboro, Foxboro, MA;
3. Badger Meter, Milwaukee, WI
4. Or approved equal.

D. Shut-off valves shall be as manufactured by:

1. Swagelok Company, Solon, OH;
2. Anderson Greenwood-Emerson, Anaheim, CA;

3. Tylok, Euclid, OH
4. Or approved equal.

E. Heated enclosures for outdoor FMIDs shall be a manufactured by
1. O'Brien, St Louis, MO
2. Or approved Equal

F. Manifolds shall be as manufactured by:
1. Swagelok Company, Solon, OH;
2. Anderson Greenwood-Emerson, Anaheim, CA;
3. Tylok, Euclid, OH;
4. Or approved equal.

G. Signal Loop Isolators shall be as manufactured by:
1. Moore Industries, North Hill, CA;
2. Acromag Inc., Wixom, MI;
3. Or approved equal.

H. Loop Power Supplies shall be as manufactured by:
1. Acopian, Easton, PA;
2. Acromag Inc., Wixom, MI;
3. Or approved equal.

I. Signal Splitters shall be as manufactured by:
1. Moore Industries, North Hill, CA;
2. Or approved equal.

J. Chart Recorder shall be as manufactured by:
1. Eurotherm Chessell Ashburn, VA;
2. Or approved equal.

K. Pressure Gauges shall be as manufactured by:
1. Ashcroft, Stratford, CT;
2. Wika Instrument Corp., Lawrenceville, GA;
3. Ametek, Berwyn, PA;
4. Or approved equal.

L. Pressure Transmitters shall be as manufactured by:
1. Emerson Rosemount, Shakopee, MN;
2. ABB, Cary, NC;
3. Endress and Hauser, Greenwood, IN;
4. Or approved equal.

M. Differential Pressure Switches shall be as manufactured by:

1. Sor, Lenexa, KS;
2. Ashcroft, Stratford, CT;
3. Mercoid, Michigan City, IN;
4. or approved equal.

N. Temperature switches shall be as manufactured by:

1. Sor, Lenexa, KS;
2. Ashcroft, Stratford, CT;
3. Or approved equal.

O. Combustible Gas (Methane, H2S) Analyzers shall be as manufactured by:

1. MSA The Safety Company, Pittsburg, PA;
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General Features

1. All FMIDs supplied shall be the manufacturer's latest design.
2. Unless otherwise specified, FMIDs shall be solid state, electronic, using enclosures to suit specified environmental conditions.
3. Microprocessor-based FMIDs equipment shall be supplied unless otherwise specified.
4. All FMIDs shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Contract Drawings, or as required.
5. Equipment installed in a hazardous area shall meet Class, Group, and Division requirements as shown on the Contract Drawings.
6. All FMIDs for outdoor service shall be furnished in the specified enclosures and or installed in field panels in accordance with Section 40 67 16 – PMCS Panels and Enclosures.
7. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for FMIDs which will be subsequently mounted in separate in field panels.
8. All field mounted transmitters mounted outdoors shall be factory installed in thermostatically controlled electrically heated enclosures.
9. Heated enclosures shall be O’Brien VIPAK series or approved equal.
10. Unless otherwise shown or specified, local indicators shall be provided for all FMIDs

11. Where FMIDs are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in this Section.

12. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position).

13. Unless otherwise specified, FMIDs and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper free cast aluminum NEMA 4X construction

14. Where separate sensors and transmitters are required, they shall be fully matched, and unless otherwise noted, transmitters installed adjacent to the sensor.

    a. Special cables or equipment shall be supplied by the associated equipment manufacturer.

15. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus.

16. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations.

17. FMIDs and system components shall be designed for installation in dusty, humid, and corrosive service condition.

18. The PMCS shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production.

19. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

20. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 1115 V, plus or minus 10 percent, except where specifically noted.

21. All regulators and power supplies required for compliance with the above shall be provided.

22. Where equipment requires voltage regulation, power conditioners shall be supplied.

23. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise.

B. Pressure Sensing Lines and Accessories for Flow and Pressure Transmitters

1. Construction:

    a. Material: Type 316 stainless steel tubing; .035-inch wall thickness.

    b. Pressure Rating: 150 psi.

    c. Size: 1/2-inch outside diameter.

d. Connections: Type 316 stainless steel compression type. "Swagelok," provide isolation valves at process tap

C. Shut-off and Isolation Valves:

1. Construction:

a. Type: Ball.

b. Pressure Rating: 150 psi.

c. Body, Ball, and Stem: Type 316 stainless steel.

d. Packing: High Density TFE.

e. Handle Stainless Steel with metal travel stops.

f. Support Rings: Stainless steel.

g. End Connections: 1/2 inch NPTF (minimum) w/ Removable "Swagelok" connectors.

D. Manifolds:

1. Construction:

a. Type: 5-valve and 3-valve meter manifolds.

b. Materials: Type 316 stainless steel body, bonnets, stems, and hardware; Delrin seats; Teflon packing.

c. Connections: 1/2 inch NPTF with Type 316 stainless steel compression type. "Swagelok" connectors.

E. Level Switch Float Type

1. Design:

a. Type: Direct acting, pear shaped, eccentrically weighted displacement type, liquid level sensor.

b. Float Body: Hollow hermetically sealed, rigidly molded of polypropylene containing switch and eccentric metal weight.

c. Switch: Hermetically Sealed SPDT switch rated 8 Amps AC, 5 Amps DC, cushioned and mounted along the main axis at about 65-degree inclination. No mercury permitted.

d. For multiple floats provide 316 stainless steel mounting rod and all required mounting hardware per manufacturer’s recommendation.

e. Weight: Weight to cause the sensor to hang straight down from cable when not immersed and only allow the float to pivot when immersed in liquid.

f. Electrical Cable:

1) Heavy duty, three conductors, flexible and submersible cable, sheathed in PVC and connected to float and switch with a watertight seal.

2) Cable length shall be sufficient to extend to the control panel box.

F. Level Transducer Submersible Type

1. Description

a. Type: Submersible pressure/level transducer.

b. Application: Wastewater, raw sewage

c. Location: Wet well, explosionproof, Class I, Div. 1

2. Function/Performance

a. Output signal: 4 mA to 20 mA, 2-wire

b. Pressure ranges: 0 inch H_2O to 50 inches H_2O through 0 psig to 350 psig.

c. Accuracy: ±0.25 % full scale (BFSL); optional ±0.125% full scale (BFSL), for ranges ≥ 150 inH2O (Includes the effects of non-linearity, hysteresis, non-repeatability, zero point and full scale errors)

d. Stability: ≤ ±0.2% full scale for 1 year, non-accumulating

e. Response time: ≤1 ms (between 10% and 90% full scale)

f. Service life: 100,000,000 load cycles

g. Temperature ranges:

1) Compensated: 32 °F to 122 °F (0 °C to 50 °C)

2) Zero effect: ±0.011% full scale/ °F within compensated range

3) Span effect: ±0.011% full scale/ °F within compensated range

4) Media: 14 ºF to 140 ºF (-10 ºC to 60 ºC)

5) Ambient: 14 ºF to 140 ºF (-10 ºC to 60 ºC)

6) Storage: 14 ºF to 140 ºF (-10 ºC to 60 ºC)

h. Proof pressure 2 times range

i. Burst pressure 3 times range

j. Electrical:

1) Voltage: 24 Vdc loop-powered from control panel.

2) Output: 4 mA to 20 mA, 2-wire

3) Load limitations: ≤ (VPower-10)/0.020 Amp-(0.043 Ω x length of cable in feet)

4) Electromagnetic rating CE compliant to EMC norm EN 61326:2014/A1:1998, RFI, EMI and ESD protection

5) Electrical protection Reverse polarity, over-voltage and short circuit protected

k. Accuracy: ±0.25 % full scale (BFSL); optional ±0.125% full scale (BFSL), for ranges ≥ 150 inH2O (Includes the effects of non-linearity, hysteresis, non-repeatability, zero point and full scale errors)

l. Stability: ≤ ±0.2% full scale for 1 year, non-accumulating

m. Response time: ≤1 ms (between 10% and 90% full scale)

n. Service life: 100,000,000 load cycles

o. Temperature ranges:

1) Compensated: 32 °F to 122 °F (0 °C to 50 °C)

2) Zero effect: ±0.011% full scale/ °F within compensated range

3) Span effect: ±0.011% full scale/ °F within compensated range

4) Media: 14 ºF to 140 ºF (-10 ºC to 60 ºC)

5) Ambient: 14 ºF to 140 ºF (-10 ºC to 60 ºC)

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p. Proof pressure 2 times range

q. Burst pressure 3 times range

r. Electrical:

1) Voltage: 24 Vdc loop-powered from control panel.

2) Output: 4 mA to 20 mA, 2-wire

3) Load limitations: ≤ (VPower-10)/0.020 Amp-(0.043 Ω x length of cable in feet)

4) Electromagnetic rating CE compliant to EMC norm EN 61326:2014/A1:1998, RFI, EMI and ESD protection

5) Electrical protection Reverse polarity, over-voltage and short circuit protected

3. Physical

a. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion-resistant housing. Where indicated on the

Drawings, transducers shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.

b. The surface of transducers shall be Teflon-coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.

c. Transducers shall be capable of being completely submerged without damage.

d. Transducers shall be suitable for the surface, pipe, or flange mounting as indicated on the Contract Drawings or Instrument Device Schedule. Appropriate mounting hardwired shall be provided. Flange shall be six inches and be resistant to attack by the medium being metered or, where required, shall be protected by corrosion- resistant coatings and facings.

4. Options/Accessories Required

a. Transducers located in areas where freezing condensation may occur shall be provided with special heaters or another type of transducer protection designed to prevent sensor icing.

b. A signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1200 feet, shall be as required by installation indicated on the Contract Drawings.

5. Transmitter/Converter

a. Type

1) Microprocessor based compatible with the transducer(s) provided.

2) Functional/Performance

a) Resolution (including transducer): Plus or minus 0.1 percent of range or 0.08 inches, whichever is greater.

b) Accuracy (including transducer): Plus or minus 0.25 percent of range or 0.24 inches.

c) Range: As required by the installation indicated on the Drawings.

d) Temperature Range: -20 to 50 degrees C.

e) Output: Two isolated 4-20 mA output and one, three, or six alarm contacts adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC.

f) Temperature Compensation: Compensation over the temperature range of the sensor.

g) Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Drawings or in the Instrument Device Schedule.

h) Diagnostics: On-screen instructions and display of self- diagnostics.

i) Loss of Signal: Transmitter shall ignore the momentary loss of echo signals and shall indicate loss of echo on the transmitter unit.

j) Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.

b. Physical

1) The transmitter shall be suitable for surface or pipe stand mounting.

2) The enclosure shall be NEMA 4X.

3) A/C power will be as specified in the Contract Documents.

c. Accessories Required

d. Hand-held programmer where required for configuration and calibration of the instrument.

G. Signal Loop Isolator

1. Design:

a. Provide the necessary quantity to perform all monitoring and control functions as specified and shown on the Contract Drawing.

b. Type: Isolator type signal converter/transmitter/transducer that accepts any standard or many non-standard input signals and produces a 4-20 mA output or another standard process current or voltage signal with three-way isolation (power, signal input, and signal output all isolated from each other).

2. Construction and Required Features:

a. Span Adjustment: 22-turn front panel potentiometer.

b. Zero Adjustment: 22-turn front panel potentiometer.

c. Housing: General purpose enclosure designed for internal panel mounting.

d. Power Supply Input: 117 VAC, 50/60 Hz.

e. Interference Protection: Built-in RFI/EMI protection.

3. Performance Requirements:

a. Calibration Capability: 0.2 percent of span.

b. Ambient Temperature:

1) Range: + 32 F to +158 F.

2) Effect: ± 0.02 percent per Deg F over the entire range.

c. Frequency Response: 5 Hz.

d. Input Current: 4-20 mA into 50 Ohms nominal.

e. Input Voltage: 1-5 Volts.

f. Output Current: 4-20 mA into 0-1200 Ohm load.

g. Output Voltage: 1-5 VDC at 0.25 mA DC max.

h. Span Adjustment: 100 percent ± 25 percent of span, with full scale input.

i. Zero Adjustment: 0 percent ± 10 percent of span, with minimum input.

j. Load Effect: ± 0.02 percent of the span from 0 to maximum load resistance.

H. Temperature Sensor/Transmitter

1. Sensor Element

a. Type:

1) Three wire platinum RTD.

b. Function/Performance:

1) Range: As required by the measuring range indicated in the Instrument Device Schedule.

2) Accuracy: Resistance versus temperature shall meet performance requirements of IEC 751 Class B.

3) Maximum Thermal Response Time: 9 seconds to reach 50 percent sensor response when tested in flowing water according to IEC 751.

4) Temperature Coefficient: 100 ohms at 0 degrees C, with a temperature coefficient of 0.00385 ohms/ohm/degree C.

5) Self-Heating: Maximum self-heating factor of 0.15 degrees C/mW.

c. Physical:

1) 316 stainless steel sheath.

2) Spring loaded sensor assembly.

3) Sensor shall penetrate into the pipe where it is installed, by 1/3 to 1/2 of the pipe diameter.

4) Sensor shall be provided with covered connection head. Sensor and connection head shall be NEMA 4X. Where indicated on the drawings to be installed in a hazardous location, the sensor assembly shall be explosion proof approved for Class I, Division 1, Groups C and D.

d. Accessories Required:

1) Sensors shall be installed in 316L stainless steel thermowells. Where exposed to corrosive gasses such as odorous air in odor control applications, thermowells shall be Hastalloy. Thermowells shall be threaded.

2) Extensions shall be provided for sensors installed in insulated pipe. Extensions shall clear the pipe insulation. Extensions shall also be provided where process temperatures are above 100 degrees C.

2. Transmitter:

a. Type:

1) Remotely mounted, two wire, intelligent transmitter compatible with a sensor provided.

b. Function/Performance:

1) Digital Accuracy: plus or minus 0.2 degrees C.

2) Stability: plus or minus 0.1 percent or 0.1 degrees C, whichever is greater, for 24 months.

3) Operating Temperature: -40 to 85 degrees C.

4) Output: 4 20 mA DC linear with temperature. The transmitter shall also communicate using HART protocol.

5) The output may be set as difference or average of two measured temperatures.

6) The output may be configured for custom curves including Callendar-Van Dusen correction.

7) Display: Digital indicator displaying temperature in engineering units.

c. Diagnostics:

1) Self-diagnostics with transmitter failure driving output to above or below out of range limits.

2) LED indication of transmitter faults.

3) Simulation capability for inputs and loop outputs.

4) Test terminals available to ease connection for test equipment without opening the loop.

5) The run-time clock shall be available to determine usage for warranty purposes. 5-year warranty on this clock reading is included.

d. Physical:

1) The enclosure shall be NEMA 4X. Where indicated on the drawings to be installed in hazardous locations, the transmitter shall be explosion proof approved for Class I, Division 1, Groups C and D.

2) The power supply shall be 24 VDC loop powered.

I. Differential Pressure Switch

1. Type:

a. Diaphragm actuated.

2. Function/Performance:

a. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.

b. Dead Band: Fixed deadband.

c. Over Range Protection: Over range protection to twice the maximum process line pressure.

d. Output: Dry contacts rated 10 A at 230 VAC. Single pole double throw (SPDT) unless the requirement for double pole double throw (DPDT) switches is shown on the instrument device schedule.

3. Physical:

a. Housing: NEMA 4X (IP65) for nonhazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB T5).

b. Switching Assemblies: Hermetically sealed switches.

c. Wetted Parts: Type 316L stainless steel diaphragm, viton seals, 316 stainless steel connection port.

4. Accessories/Options Required:

a. For each differential pressure switch, provide a three-valve manifold. The manifold shall be 316 stainless steel.

J. Magnetic Flowmeter

1. Type:

a. Magnetic, electromagnetic, or mag meter

b. Process Fluid: Wastewater, raw sewage

c. Line Size: as shown on Contract Drawings.

2. Function/Performance:

a. SMART™ Meter Verification (SMV) to verify the health of the flowmeter and accuracy of readings.

b. Continuous SMV to confirm meter calibration without interrupting the process.

c. Accuracy: Up to 0.15% of volumetric flow rate accuracy over 13:1 flow turndowns, 0.25% over 40:1 flow turndown.

d. Electrode Coating Diagnostic to indicate when preventive maintenance is needed to avoid unexpected downtime.

e. Grounding/Wiring Fault Detection to detect if AC noise is affecting the flow reading.

f. Tunable Empty Pipe Detection to notify user if the pipe is not full.

3. Physical:

a. Sensor Mounting: In line, flange type.

b. Liner Materials: PTFE

c. Electrode Material: 316L Stainless Steel

d. Flange Standard: ANSI, EN, GB, AS4087, AS2129, JIS, AWWA

e. Flange Rating: Up to 300# / PN40 / 4.0Mpa / PN35 / Table E / 10K / Class F

f. Transmitter Mounting: Wall Mount or on supports

g. Output: 4-20mA DC

h. Power Supply: 24V DC

i. Hazardous Area Approval: Ordinary Location, FM Class I Div 2, ATEX/IECEx Zone 2, NEPSI Zone 2

j. Sensor Ingress Protection IP68

k. Welded coil housing to provide protection against moisture ingress and sustained vibrations

l. Dual compartment transmitter housing to keep the electronics fully isolated from moisture and contamination.

m. Replaceable terminal block enables repair in the field.

4. Accessories/Options Required:

a. Include ability to print SMV report to verify meter performance for regulatory agencies.

b. Provide Universal Transmitter capabilities to allow easy access to diagnostic information using any manufacturer's sensor.

c. Provide Local Operator Interface with dedicated keys for easy configuration.

d. Mount transmitter on wall or independent supports, approximately five (5) above floor for easy reading, near mag meter. Follow manufacturer's instructions.

e. Provide manufacturer's cable from sensor to transmitter.

f. Provide stainless steel identification nameplate with engraved marking of instrument tag number and description.

K. Pressure Transmitters:

1. Type: Solid State two-wire, differential capacitance or resonant wire type transmitter.

2. Function: Monitor system pressures as shown and as specified in the Instrument Index. The transmitter shall display the monitored pressure value and shall output a 4 to 20 mADC signal proportional to the monitored pressure.

3. Performance Requirements:

a. Range: As specified in the Instrument Index.

b. Positive Overrange Protection: At least 1.25 times the maximum span limit.

c. Local Indication: As specified in the Instrument Index.

d. Accuracy (includes combined effects of linearity, hysteresis, and repeatability): ±0.10 percent of calibrated span.

e. Repeatability: 0.05 percent of calibrated span.

f. Hysteresis: 0.05 percent of calibrated span.

g. Stability (drift over a six month period): Not more than ±0.25 percent of transmitters upper range limit.

h. Power: Designated to operate on power from receiver or remote power supply, nominal 24 VDC.

i. Supply Voltage Effect: Output change not greater than 0.005 percent of span for each one volt change in supply power.

j. Output:

1) Isolated direct acting 4 to 20 mADC.

2) Digital process variable signal superimposed on 4 to 20 mADC signal without compromising loop integrity.

k. Ambient Temperature Limits: -20 to +180 degrees F.

l. Ambient Temperature Effect (Total Error per 100 degrees F change between the Ambient Temperature Limits): Not more than ±1.0 percent of the transmitters upper range limit (maximum span).

L. Pressure Gauges:

1. Type: Bourdon Tube Pressure Element Type, Liquid Filled Gauge (for pressure ranges of 15 psi and greater and vacuum ranges to 30-inches Hg):

2. Performance Requirements:

a. Range: As specified in the Instrument Index.

b. Accuracy: ±0.5 percent of span (ANSI B40.1 Grade 2A).

3. Construction Features:

a. Case:

1) Solid front design constructed of glass filled polyester.

2) Color: Black.

b. Size: 4-1/2-inch.

c. Ring: Threaded, glass filled polyester.

d. Window: Glass.

e. Dial: White with black markings.

f. Filling Liquid: Silicone oil.

g. Overpressure protection: Full blowout back.

h. Bourdon Tube and Socket:

1) Type 316 stainless steel.

2) Heliarc welded, unless otherwise specified.

i. Movement:

1) Type 300 series stainless steel.

2) Rotary geared with Teflon S coating, or cam and roller type.

3) Built-in overload and underload movement stops.

j. Connection: 1/4-inch male NPT, bottom.

k. Mounting: Stem Mount.

l. Calibration:

1) Adjustable pointer.

2) Externally accessible zero adjustment.

4. Accessories:

a. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless steel housing with 1/4-inch NPT male and female connections.

b. Process Isolation: Provide ball valves for process isolation in accordance with the requirements of Article 2.1, above.

M. Combustible Gas (Methane and Hydrogen Sulfide) Analyzers:

1. General: Combustible Gas (Methane and Hydrogen Sulfide) Analyzer shall measure and display gas concentration at the two Vestibules and provide alarms as noted in the Alarm Monitoring Control Schematic when preset limits are exceeded.

2. Provide one Combustible Gas (Methane and Hydrogen Sulfide) Analyzer (sensor and transmitter) in each Vestibule with alarm contacts wired to the Alarm Monitoring Panel as noted on the drawings.

3. Required Features:

a. Combustible Gas Sensor:

1) Type: Catalytic oxidation.

2) Range: 0 to 100 percent lower explosive limit (LEL).

3) Repeatability: ± One percent full scale.

4) Temperature Range: -40 to 155 degrees F.

5) Response Time: Less than 60 seconds to read 90 percent of step change.

6) Drift: ± One percent of full scale per week.

7) Sensor Life: Three years minimum.

8) Filter: Provide for protection from dust.

9) Sensor Guard: Required for moisture protection.

10) Enclosure: Explosion proof.

b. Environmental Requirements:

1) Temperature Range: -40 º C to +40 º C (-40 ºF to + 140 º F).

2) Humidity: 15-95 % Relative Humidity (non-condensing).

c. Sensor Electrical Rating: Class 1 Division 1 Groups A, B, C, D.

d. Installation Hardware: Provide Mounting Kit as required for installation of sensors and transmitters, and in accordance with manufacturer recommendations.

e. Transmitter:

1) One transmitter shall be provided with an integral sensor.

2) Type: With integral display and capable of non-intrusive intrinsically safe calibration.

3) Alarm Contacts: Three SPDT Relays. Configure for a Fault alarm.

4) Transmitter Power: 24 VDC, supplied over 3-wires current source.

5) Transmitter Output: (2) 4-20 mADC, available, but not used.

6) Transmitter Display: Organic LED; shall indicate power on, gas concentration, alarm, and fault conditions. Visible from a minimum of 5 feet and shall be present at all times.

f. Accessories:

1) Provide manufacturer recommended accessories.

2) Tagging: Provide 316 SS engraved tag for sensor and transmitter required. Tags shall clearly indicate name of associated gas in addition to instrument tag and other required information for ease of identification.

3) Provide 316 S.S. mounting hardware.

g. Calibration Equipment:

1) Calibrator: The calibrator shall provide a quick and convenient method of checking response of the gas sensor. The calibrator shall be a non-intrusive hand-held unit. When local calibration cannot be achieved due to inaccessibility of a sensor remote calibration equipment (tubing, remote, adaptor, etc.) shall be furnished and installed.

2) Calibration Gases: The following equipment shall be supplied:

a) Regulator, gauge, and carry case.

b) Adaptor hose with sampling line connection.

c) One year's supply of calibration gas for each sensor. Assume each sensor is calibrated once per month. Submit calculations which determine number of calibration gas bottles to be supplied.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. FMIDs shall confirm to the requirements of Section 40 80 81 – PMCS Factory Testing.

B. FMIDs monitoring and control criteria specified under this Section shall be functionally verified during PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Contractor shall install each FMID in accordance with manufacturer's recommendations, this Section and the Contract Documents.

B. Equipment shall be located so that it is accessible for operation and maintenance.

C. The PMCS Supplier shall examine the Contract Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Section.

D. Electrical work shall be performed in compliance with NYCEC.

E. Equipment Mounting and Support

1. Field equipment shall be mounted on prefabricated pipe stands or metal framing unless shown adjacent to a wall or otherwise noted.
2. FMIDs attached directly to concrete shall be spaced from the mounting surface not less than 1/2-inch by use of phenolic spacers.
3. Expansion shields in walls shall be used for securing equipment or wall supports to concrete surfaces.
4. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
5. Embedded pipe supports and sleeves shall be schedule 40, Type 316 stainless steel pipe, with stainless steel blind flange for equipment mounting as shown on the Contract Drawings.
6. Materials for miscellaneous mounting brackets and supports shall be Type 316 stainless steel construction.
7. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the Contract Documents..
8. Where transmitters are supported from process piping, leveling saddles shall be provided.
9. Transmitters shall be oriented such that output indicators are readily visible.

F. Panels into which FMIDs are to be mounted shall provide rigid structural support for the FMIDs and shall allow necessary access and working space to permit maintenance of the FMID while installed.

G. Additional strengthening and/or bracing required for a sound installation shall be provided as part of this contract.

H. Contractor shall provide all supports, bracing, wiring, and incidental hardware.

I. All software required for the FMIDs shall be loaded, configured and fully tested as part of this contract.

J. Contractor shall configure the FMIDs using function keys and instructional prompts so that operators can operate equipment, modify set points and presets and monitor the FMIDs without any special training or knowledge of the controller with which the FMIDs interfaces.

K. Identification Tags

1. All FMIDs shall have an identification tag meeting the following requirements:

a. Tag numbers for FMIDs shall be as listed on the Contract Drawings and Instrument Index attached.

b. The six digit prefix shall be included with the ISA tag number.

c. The identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.

d. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.

e. All FMIDs mounted on or within panels shall have the stainless steel identification tag installed so that the numbers are easily visible to service and maintenance personnel.

3.03 FIELD TESTING / QUALITY CONTROL

A. FMIDs Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

B. Section 40 80 82 – PMCS Startup and Field Testing details how FMIDs specified under this Section shall be verified during Field Testing.

C. The Engineer, or his designated representative(s), reserve the right to witness any test, inspection, calibration or start-up activity.

D. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

E. The PMCS Supplier shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions.

F. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to DEP.

G. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

H. Field Instrument Calibration Requirements

1. Each FMID shall be calibrated at 0, 25, 50,75 and 100 percent of span using test instruments to simulate inputs and read outputs.

2. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated.

3. If doubt exists as to the correct method for calibrating or checking the calibration of an FMID, the manufacturer's recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

4. Upon completion of calibration, FMIDs calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations.

5. Caution shall be exercised to prevent such FMIDs from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air.

6. Damaged FMIDs shall be replaced and recalibrated at no cost to DEP.

7. After completion of FMID installation, the PMCS Supplier shall perform a loop check.

8. The Contractor shall submit final loop test results with all FMIDs listed in the loop.

9. Loop test results shall be signed by all Contractor representatives involved for each loop test.

10. Where applicable, test instruments shall have accuracies as set forth by NIST.

I. Calibration Reports

1. The PMCS Supplier shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy.

3.04 STARTUP / DEMONSTRATION

A. Section 40 80 82 – PMCS Startup and Field Testing details the requirements for OAD and PMCS Upset and Recovery Testing.

B. The OAD and the PMCS Upset and Recovery Testing shall serve as the final verification of the correct functioning of all FMIDs.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 80 81 – PMCS FACTORY TESTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to perform Witnessed Factory Acceptance Testing of all equipment and components of the PMCS, at the manufacturer's facility.

B. Witnessed Factory Acceptance Testing shall verify that the PMCS, its components, and associated equipment function properly both as units and as integrated systems and that the functional and performance requirements of the Contract Documents are met.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	6
3.01	Examination / Preparation	6
3.02	Installation	6
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	7

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1. Costs under this Section shall include travel, transport, board and lodging for two representatives of the City and one representative of or the Engineer

to attend all PMCS WFAT at the PMCS manufacturer's facility or approved test facility, in accordance with Section 01 43 15 – Witness Shop Testing.

2. If PMCS equipment and associated components or part thereof require retesting and witnessing is required the Contractor shall be responsible for the associated cost in addition to the travel, transport, board, lodging, and time cost of the witnesses.

1.03 RELATED SECTIONS

A. Section 01 43 15 – Witness Shop Testing

B. Section 40 61 13 – PMCS General Requirements

C. Section 40 80 82 – PMCS Startup and Field Testing

1.04 REFERENCES

A. Definitions

1. WFAT - Witnessed Factory Acceptance Tests

2. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS.

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. General

1. The intent of the WFAT is to ensure that all equipment and components of the PMCS and peripherals to be supplied by the Contractor and intended for operation in the Contract Facility and as defined in the Contract Documents demonstrate their performance over their design ranges as individual units and as an integrated system.

2. All the Control Strategy submittals which have been approved for integration into the PMCS and associated equipment shall be demonstrated over the full range of their designed operation.

3. Every attempt shall be made during the WFAT to resolve any issues arising.

4. No issue observed during the WFAT shall be left for resolution during Field Testing unless approved by the Engineer.

5. The Contractor shall provide all necessary supervision, personnel, materials, fluids, facilities, temporary test setups, test fixtures, test equipment, and simulation where approved to perform satisfactory and complete testing.

6. The City representative, Engineer and the Contractor's representative shall be present for all WFATs.

7. Presence of the City and the Engineer at the WFAT does not relieve the Contractor from conforming to the requirements of the Contract Documents.

8. Presence of the City and the Engineer at the WFAT shall in no way imply Acceptance of the PMCS equipment or its components.

B. HMIs

1. Prior to the staging and testing of the system, all display environments shall have been configured per the agreed upon display structure, loaded and data base parameters linked to the specified fields.

C. Notifications and Scheduling

1. The WFAT shall not be scheduled or begun, until all related PMCS Shop Drawings, Test Procedures, Test Documentation and Schedules have been submitted and approved.

2. Integrated PMCS WFAT shall only be scheduled after the PMCS supplier has conducted a non-witnessed factory test and certified that the complete PMCS and associated equipment are ready for a WFAT.

3. The Contractor shall notify the Engineer in writing 60 days before expected initiation of the WFAT.

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. All PMCS components and associated equipment shall be inspected.

1. Inspection shall include but not be limited to the following:

2. Nameplates and tags

3. Wire sizes and color coding

4. Annunciator and terminal block spares

5. Proper wiring practices and grounding

6. Enclosure flatness, finish and color.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit information on factory testing procedures and schedules to verify that testing shall fulfill the requirements specified in this Section and the Contract Documents.

C. Submittal shall be made at least 60 days months in advance of any scheduled testing and shall include dates of scheduled tests.

D. The procedures for WFATs detailed in this Section shall be submitted for approval by the Engineer.

E. The details of simulation panel or simulation software which will be used in conjunction with the PMCS equipment shall submitted for to the Engineer for approval.

F. Reports

1. A report on the WFATs completed shall be submitted to the Engineer for approval.

2. Factory test reports shall include the following information:

a. List of tests performed.

b. Certified check lists or documentation verifying all I/O has been tested, as specified in this Section.

c. Document verifying all panel wiring has been checked and conforms to the approved submittals with any correction made during the testing.

d. List of all modifications or corrections identified during the WFAT and corrective action taken.

e. Equipment shall not be shipped from the factory until certified factory test reports indicating satisfactory performance have been submitted and approved by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Factory Testing shall be as implemented by the PMCS Supplier.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. HMIs Demonstration

1. The overall display structure shall be demonstrated, including environment configurations, passwords, security, etc.
2. The display contents of memos shall be reviewed to demonstrate how an operator navigates within the overall display structure.
3. The assignment of displays to annunciator keys shall also be demonstrated.
4. Each graphic display shall be reviewed for correctness in terms of the layout, symbols, color scheme, etc.
5. The operation of standard alarm management displays (Current Alarm Display. Alarm History, etc.) shall also be demonstrated.
6. A demonstration of each type of report specified shall be performed.
    a. Printing to PDF shall be an integral part of the report demonstration.

B. PMCS Hardware Operational Testing

1. All input/output devices and components shall be tested to verify operability and basic calibration.
2. All PMCS hardware components and associated equipment shall be tested to verify proper operation of the equipment as standa lone units. Test shall include, but not be limited to, the following:
    a. AC/DC power checks
    b. Power fail/restart tests
    c. Diagnostics checks
    d. Test demonstrating that all specified equipment functional capabilities are working properly.
3. All system components shall be tested to verify that communication between units is working properly.
4. An integrated P M C S test with all system equipment connected (excluding field sensors and instruments) shall be performed to verify that· all equipment is performing properly as an integrated system.
5. All field sensors and instruments shall be simulated over their operating ranges inclusive of major set points.

C. PMCS Software Demonstration

1. Contractor shall demonstrate all system software, utility and security programs incorporated into the PMCS to illustrate the various functions and capabilities specified.

2. Contractor shall demonstrate the operation and display of all software based on a simulation of 20 percent of total input/output count, both analog and discrete, as selected by the manufacturer.

3. The City/Engineer shall also randomly select, at the time of the test, additional inputs and outputs to be simulated in an amount approximately equal to 10 percent of total input/output count.

4. Demonstration shall show that the monitoring and control application software associated with the input/output points performs the functions intended.

D. System performance shall be tested using a fully integrated system, including all software and hardware .

1. The entire control system, including all the peripheral devices and all interconnecting cables, shall be assembled on the factory test floor and simulated inputs applied.

2. Every device shall have nameplate with description and device's P&ID tag number.

3. Nameplates shall be removable and interchangeable for multiple use during the test.

4. Simulated inputs/outputs shall at minimum include:

   a. Toggle switches to simulate field or other input contacts

   b. Indicating lights to simulate outputs from tested panels

   c. Control relays to simulate MCC coil inputs

   d. Time relays to simulate position switches

   e. Indications (mA) to indicate every 4-20 mA output from tested panel

   f. Potentiometers to simulate 4-20 mA inputs to tested panel

5. The Contractor shall carry out a full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents

E. Demonstration of communication between PLC's or to remote I/O's shall be included in the Test Procedure where applicable.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Field Testing

1. Field Testing shall conform to the requirements of Section 40 80 82 – PMCS Startup and Field Testing.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 80 82 – PMCS STARTUP AND FIELD TESTING
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all supervision, labor, materials, equipment and incidentals as shown, specified and required to furnish and install all equipment and coordinate all activities necessary to perform check out, start up and field testing of the PMCS and all associated equipment.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	5
PART 2	PRODUCTS	5
2.01	Manufacturers	5
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	5
2.04	Source Quality Control / Shop Tests	5
PART 3	EXECUTION	5
3.01	Examination / Preparation	5
3.02	Installation	6
3.03	Field Testing / Quality Control	6
3.04	Startup / Demonstration	7
3.05	Adjusting / Protection / Cleanup	11

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 40 61 13 – PMCS General Requirements.

B. Section 40 79 91 – PMCS Field Instruments

C. Section 40 78 90 - PMCS Panel Mounted Instruments and Devices

D. Section 40 80 81 – PMCS Factory Testing

1.04 REFERENCES

A. Definitions

1. SFT – Start-up and Field Testing.
2. OAD – Operational Availability Demonstration.
3. URT – Upset and Recovery Testing.
4. WFAT – Witnessed Factory Acceptance Tests.
5. Section 40 61 13 – PMCS General Requirements defines the terms and abbreviations used in this Section and the PMCS

B. Reference Standards

1. Section 40 61 13 – PMCS General Requirements lists the standards applicable to this Section and the PMCS.

1.05 DESCRIPTION

A. Start-up and Field Testing of the PMCS and associated equipment shall include but not be limited to the following:

1. Check Out, Start up and Initial Operation of Equipment.
    a. Instrument calibration and operation
    b. Cable and wire testing
    c. Instrument Loop testing
    d. Control panel installation test
    e. Local control of equipment
    f. PLC and I/O operation
    g. I/O loop testing
2. Final Field-testing of Equipment
    a. Control panel operational testing
    b. Instrument full operation testing
    c. Verification of local and remote control of individual equipment
    d. Execution of control strategies for individual equipment
3. Check Out, Start up and Initial Operation of System Equipment
    a. Process control panel local system operation
    b. Preliminary loop tuning
    c. Remote control of systems
    d. Individual and system loop operation

e. Network and communication link testing

f. Network and communication performance testing

g. Execution of local system logic and control

4. Final Field-testing of Systems

a. Execution of control strategies for equipment systems

b. Network and communication optimization

B. Integrated System Field Test

C. Operational Availability Demonstration

D. PMCS Upset Testing

1.06 QUALITY ASSURANCE

A. The Contractor shall comply with the Quality Assurance requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. The Contractor shall retain the services of the PMCS Supplier to supervise, coordinate and perform check-out and start-up of all PMCS components and associated equipment.

C. All I/O points, loops, and functions including spares shall be fully operational and undergo Start up and Field Testing.

D. Start up and Field Testing shall be conducted on all PMCS and associated equipment including those for which Factory Testing has been completed.

E. As part of these services, the PMCS Supplier shall include for those equipment items not manufactured by him, the services of an authorized manufacturer's representative to check and certify the equipment installation and place the equipment in operation.

F. Each manufacturer's representative shall be thoroughly knowledgeable about the specific installation, and factory certified in the installation, operation, and maintenance of the equipment.

G. Start-up and Field Testing shall include but not be limited to, field and panel devices, hardware, software, communications, and programming.

H. Simulators and test equipment may be used for the following test phases:

1. Check-out, Start-up and Initial Operation of all equipment and systems

I. Actual field conditions, process variables and process fluids shall be used for the following test phases:

1. Final Tests

2. Integrated System Field Test

3. Operational Availability Demonstration

4. PMCS URT

J. The PMCS Supplier's personnel shall be present for and participate in all phases of the testing of the entire PMCS including all process equipment and systems monitored and controlled by PMCS.

K. Strat-up and Field Testing shall only be considered complete upon the successful performance of all specified functions.

L. Acceptance of PMCS and all associated equipment by the City is contingent upon the approval by the Engineer of all Test Reports.

1.07 SUBMITTALS

A. The Contractor shall comply with submittal requirements listed in Section 40 61 13 – PMCS General Requirements, this Section and the Contract Documents.

B. Contractor shall submit information on all SFT procedures and schedules for the approval of the Engineer, to verify that testing shall fulfill the requirements specified in this Section and the Contract Documents.

C. Submittal shall be made at least 60 days in advance of any scheduled testing and shall include dates of scheduled tests.

D. The details of simulation panel or simulation software which will be used in conjunction with the PMCS equipment shall submitted for to the Engineer for approval

E. Complete and detailed information, shall include but not be limited to:

1. Test Flow Charts outlining both the testing and responsibilities of all parties.

2. Proposed log sheets showing what, when and how all test parameters will be recorded and by whom.

3. Proposed reporting formats listing all the information to be recorded for each test

F. Test Reports

1. A report on the each SFT activity completed shall be submitted to the Engineer for approval.

2. Reports shall include the following information:

a. List of tests performed.

b. All raw field test data, test personnel notes, witness comments

c. Certified check lists or documentation verifying all I/O has been tested, as specified in this Section.

d. Test documentation demonstrating that all digital and analog points of the PMCS residing in all controllers and databases have been conformed to be accurately linked to their respective instrument tag names, database tags and assigned names real or virtual.

e. Document verifying all panel wiring has been checked and conforms to the approved submittals with any correction made during the testing.

f. Confirmation that all modifications or corrections identified during the WFAT have been incorporated into the build of the PMCS an associated equipment tested.

g. Confirmation that all modifications or corrections identified during the SFT have been incorporated into the SFT documentation marked up corrective actions taken.

G. Each major phase of test, such as OAD, shall not commence until certified test reports indicating satisfactory performance of prior major phases have been submitted and approved by the Engineer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with delivery, storage and handling requirements listed in Section 40 61 13 – PMCS General Requirements.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PMCS Start-up and Field Testing shall be as implemented by the PMCS Supplier.

2.02 MATERIALS / EQUIPMENT

A. Not Used

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. PMCS Factory Testing shall conform to the requirements of Section 40 80 81 – PMCS Factory Testing.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Not Used

3.03 FIELD TESTING / QUALITY CONTROL

A. Equipment/System Check Out, Start-up and Initial Operation

1. The Contractor, under the supervision of the PMCS supplier, and other control system and instrument suppliers as applicable, shall perform the following:

a. Coordinate and collaborate with the suppliers and field service Engineers for the following:

1) MSP-1601, MSP-1602, MSP-1603, MSP-1604, MSP-1605 and MSP-1606 Main Sewage Pumps

2) VS-7401, VS-7402 and VS-7403 Vacuum Priming Systems

3) MSPCP-1600 – Main Sewage Pumps Control Panel

4) BSCP-9120 – Backup System Control Panel

5) PMCS-9110 – SCADA Panel

6) RTU-9120 – Telemetry Panel

7) EMCS-1510 – Electrical Monitoring and Control System

8) GMCP-8510 – Generator Monitoring and Control Panel

9) MCC-1A and MCC-1B – Motor Control Centers

10) VSS-8410 – Video Surveillance System

11) RTM-1 and RTM-2 – Real-Time Metering by DCAS

12) LAP-120 and LAP-140 – Local Alarm Panels for Hazardous Gases

13) All other field-mounted and panel-mounted instruments.

b. Check and approve the installation of all PMCS components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

c. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions.

d. Where future operational functions are included in this work, they shall be included in the check-out.

e. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

2. The Contractor shall provide all test equipment necessary to perform the testing during system checkout and start-up.

3. The Contractor and PMCS Supplier shall be responsible for initial operation of system and shall make any required changes, adjustments or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended.

4. The Contractor shall furnish to the Engineer certified calibration reports for all field instruments and devices specified in Section 40 79 91 – PMCS Field Instruments and Section 40 78 90 - PMCS Panel Mounted Instruments and Devices, as soon as calibrations are completed.

5. The Contractor shall furnish the Engineer an installation inspection report certifying that all equipment has been installed correctly and is operating properly.

6. The report shall be signed by authorized representatives of both the Contractor and the PMCS Supplier.

B. Integrated System Field Test

1. The term “PMCS” as used in this Section shall mean the integrated PMCS System including all of the control panels, systems, and instruments listed in paragraph 3.03A.1.a. above.

2. Following the PMCS and associated equipment checkout and initial operation, the Contractor, under the supervision of the PMCS Supplier, shall perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational.

3. Any defects or problems found during the test shall be corrected by the Contractor and then re-tested to demonstrate proper operation.

4. The PMCS including field sensors/transducers and instruments shall be running and fully operational for a continuous 72 hour period.

5. The City and the Engineer shall agree that the Integrated System Field Test has successfully concluded with no issues to be resolved at the end of the 72 hour period.

3.04 STARTUP / DEMONSTRATION

A. Operational Availability Demonstration

1. The OAD shall commence upon approval by the Engineer after the Integrated System Field Test has been accepted by the City and the Engineer.

2. The OAD shall run continuously from initiation, for 60 days, during which time the PMCS and all associated equipment (hardware and [software])

shall achieve a minimum of a 99.9% or better availability with no system failures.

3. Any system failures which occur after the initiation of the OAD shall cause the current 60-day period to be terminated and a new 60-day period started after the correction of the failure.

4. During the OAD the PMCS and associated equipment shall be available to Pumping Station operating personnel for use in normal operation of the Pumping Station.

5. For the purpose of the OAD the system will be defined as consisting of the following systems and components:

   a. All operator interfaces

   b. All Local Control Panels including controllers and monitoring systems packaged with the equipment.

   c. All Local Control Stations

   d. All PLCs residing in equipment controlled by the PMCS.

6. The conditions listed below shall constitute system failures which count towards the termination of the OAD:

   a. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.

   b. If the same hardware or software problem occurs three times or more times.

   c. Software problem causing a processor to halt execution.

7. The following conditions shall constitute a system failure in determining the system availability based on the equation specified in this Section:

   a. Failure of any non-redundant operator interface or PLC.

   b. Loss of communications between devices on the communications network.

   c. Failure of one or more input/output components.

   d. Failure of any type affecting ten or more input/output points simultaneously.

   e. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.

   f. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system failure provided the backup power supply operates properly and maintains supply power.

g. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.

h. Failure of three or more primary sensors/transducers or field instruments simultaneously.

B. The system availability shall be calculated based on the following equation:

1. A = ((TTO)/(TTO+TTR)) x 100% where

a. A = system availability in percent

b. TTO = total time in operation

c. TTR = total time to repair

d. Time to repair shall be the period between the time that Contractor is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.

1) Actual travel time for service personnel to get to the plant site up to 6 hours per incident from the time the Contractor is notified of a system failure.

2) Time for receipt of spare parts to the plant Site once requested up to 24 hours per incident.

3) No work shall be done on the system while waiting for delivery of spare parts.

4) Dead time shall not be counted as part of the system available period.

5) The dead time shall be logged and the duration of the OAD extended for an amount of time equal to the total dead time.

C. All parts and maintenance materials required to repair the system prior to completion of the OAD shall be supplied by the Contractor at no additional cost to DEP.

D. If parts are obtained from the required plant spare parts inventory, they shall be replaced to provide a full complement of parts as specified.

E. A Plant Monitoring and Control System Malfunction/Repair Reporting Form shall be completed by the plant personnel and the Engineer to document system failures, notifications to the Contractor, arrival and repair times and the Contractor repair actions. Format of the form shall be developed and agreed upon prior to the start of the OAD.

F. PMCS Upset and Recovery Testing.

1. The Contractor shall conduct Upset and Recovery Testing of the entire PMCS provided under this contract and all equipment monitored or controlled by the System.

2. URT shall prove the fault tolerance and failure response across the entire PMCS.
3. URT shall be performed after the OAD and shall be imitated from a steady state condition of the PMCS
4. URT shall continue for three consecutive workdays (24 hours).
5. URT shall consist of intentional, non-destructive shutdown and failure of portions of the PMCS equipment, and systems.
6. The Engineer and the City shall randomly pick individual pieces of operating equipment such as [Blowers, Pumps, valves, gates, instruments, controls, etc. to be disabled or tripped and process variables and set points to be modified]
7. The PMCS and associated equipment shall respond as specified to the upset.
8. PMCS and associated equipment responses shall be monitored and recorded.
9. Various failure modes and conditions shall be tried on all equipment.
10. Failure modes to be tested shall include but not be limited to:
    a. closing valves
    b. stopping flows
    c. tripping pumps
    d. emergency stops
    e. gas detection
    f. set point changes
    g. simulated scenarios
    h. the system bypasses, etc.
    i. Multiple failure scenarios shall also be tried.
    j. Full manual and semiautomatic back up modes shall also be tested
    k. UPS run times shall be tested and several PMCS equipment “black starts” shall be attempted to test PMCS restart capability after a prolonged power outage.
    l. Workstations, servers, controllers and [software] shall be stopped; portions of and the entire network shall be disabled.
11. PMCS URT Responses
    a. The PMCS must respond immediately by
    b. generating the proper alarms
    c. starting backup or sequential equipment

d. shutting down remaining affected equipment in accordance with the Control Strategies, programmed sequences, and safety and interlock logic.

e. All equipment and controls shall respond per design.

f. Each unit or equipment controller or PLC must continue to control properly, monitor and alarm the equipment that it operates while disconnected from the PMCS.

g. Portions of the PMCS which have been stopped shall not cause usable portions of PMCS to stop running.

12. PMCS URT Recording

a. Status of the PMCS shall be recorded and monitored.

13. Unexpected or undesirable results, or failure of PMCS to correctly respond to an upset, shall result in stopping the test, making repairs or changes, retesting the changes and then restarting the test.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all professional services, labor, materials, tools, equipment, and incidentals as shown, specified, and required to retrofit the bridge crane and hoisting equipment completely and operationally.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before hoisting equipment Work.

2. Notify other trades in advance of the installation of bridge crane and hoisting equipment to provide them with sufficient time for installing items that must be installed with or before bridge crane and hoisting equipment Work.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections:	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage And Handling	5
1.09	Spare Parts, Special Tools, And Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	13
PART 3	EXECUTION	15
3.01	Examination / Preparation	15
3.02	Implementation	15
3.03	Field Testing / Quality Control	15
3.04	Adjusting / Protection / Cleanup	16

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS:

A. Section 01 78 25 - Operations and Maintenance Manual

B. Section 01 79 05 – Equipment Start-up and Training

C. Section 09 91 00 - Painting.

D. Section 26 05 91 - Low-Voltage Electric Motors

1.04 REFERENCES

A. Standards referenced in this Section are:

1.	ABMA		
2.	AGMA.		
3.	ANSI/AGMA 6013-A	-	Standard for Industrial Enclosed Gear Drives.
4.	ANSI MH 27.1	-	Specifications for Underhung Cranes and Monorail Systems.
5.	ANSI 830.11	-	Monorail Systems and Underhung Cranes.
6.	ANSI 830.16,	-	Safety Code for Overhead Hoist.
7.	AISC	-	Specification for Structural Steel Buildings.
8.	AISC	-	Code of Standard Practice for Steel Buildings and Bridges.
9.	AISC S326	-	Design, Fabrication and Erection of Structural Steel.
10.	ASCE.		
11.	ASME B30.2	-	Overhead and Gantry Cranes.
12.	ASME B30.11	-	Monorails and Underhung Cranes.
13.	ASME B30.16	-	Overhead Hoists (Underhung).
14.	ASME HST-1	-	Performance Standard for Electric Chain Hoists.
15.	ASME HST-4	-	Performance Standard for Overhead Electric Wire Rope Hoists.
16.	ASTM A36/A36M	-	Specification for Carbon Structural Steel.

17.	ASTM A193/A193M	-	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
18.	ASTM A307	-	Specification for Carbon Steel Bolts and Studs,60,000 psi Tensile Strength.
19.	ASTM A325	-	Specification for Structural Bolts, Steel, Heat-Treated, 120/105 KSI Minimum Tensile Strength.
20.	ASTM A563	-	Specification for Carbon and Alloy Steel Nuts.
21.	ASTM A572/A572M	-	Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
22.	ASTM F436	-	Specification for Hardened Steel Washers.
23.	AWS D1.1/D1.1M	-	Structural Welding Code – Steel.
24.	AWS D14.1	-	Specification for Welding of Industrial and Mill Cranes and other Material Handling Equipment.
25.	CMMA 70	-	Specification for Top Running Bridge and Gantry Multiple Girder Electric Overhead Traveling Cranes.
26.	NEC.		
27.	NEMA.		
28.	NFPA 820	-	Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
29.	OSHA.		
30.	RCSC	-	Specification for Structural Joints Using ASTM A325 or A490 Bolts.

1.05 DESCRIPTION

A. Provide and test bridge cranes, hoists, motors, gear reducers, controls and appurtenances as indicated and in compliance with Contract Documents.

1. Hoist capacities and operating data are indicated in the Bridge Crane Performance Criteria, Part 2.02, C.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

   a. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer, from single bridge crane manufacturer.

2. Bridge crane equipment manufacturer shall review and approve or prepare all Shop Drawings and other submittals for components furnished under this Section.

3. All components shall be specifically constructed for specified service conditions and shall be integrated into overall equipment assembly by bridge crane equipment manufacturer.

1.07 SUBMITTALS

A. Action Submittals: Submit the following

1. Manufacturer's Qualifications.

2. Product Data:

   a. Manufacturer's literature, illustrations, specifications, and engineering data including:

      1) Complete description in sufficient detail to permit item by item comparison with the Specifications.

      2) Dimensions and required clearances.

      3) Weights.

      4) Maximum support reactions.

      5) Performance characteristics.

      6) Manufacturer's installation and testing instructions.

      7) Affidavits of compliance with referenced standards and codes.

      8) Manufacturer's standard guarantee.

      9) Manufacturer's Installation Report.

   b. Motor test data in accordance with Section 26 05 91, Low-Voltage Electric Motors.

   c. List of any deviations from the Contract Drawings.

3. Shop Drawings:

a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.

b. Dimensions and required clearances.

c. Drawings and information for controls logic and wiring.

d. Motor Shop Drawings in accordance with Section 26 05 91– Low-Voltage Electric Motors.

4. Testing Plans: Prior to performing tests, submit and obtain Engineer's approval of test procedures for field operating tests.

5. Quality Control:

a. Test procedures for shop and field performance tests.

b. Written report of the results of the shop and field tests.

B. Informational Submittals: Submit the following (for jib crane and monorail systems):

1. Manufacturer's Reports: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.

2. Source Quality Control Submittals:

a. Motor shop test results in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

3. Field quality control Submittals:

a. Results of motor tests at the Site in accordance with Section 26 05 91 – Low-Voltage Electric Motors.

4. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.

C. Closeout Submittals: Submit the following:

1. Operational and Maintenance Data:

a. Submit complete operation and maintenance manuals, including copies of test reports, maintenance data, and schedules, descriptions of operation, and spare parts information.

b. Required Operation Data: Explanation of all safety considerations relating to operation.

c. Furnish operation and maintenance manuals per Section 01 78 25 – Operations and Maintenance Manual.

1.08 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Assemble components in the factory to the greatest extent possible prior to shipping.

2. Packing:

   a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.

   b. Protect machined surfaces and mating connections.

   c. Protect bearings and gearing with a shop applied corrosion prevention coating.

   d. Cover all openings into gear boxes with vapor inhibiting and water repellent material.

   e. Crate in a manner which will prevent damage during shipment, delivery and storage.

   f. Identify crate contents by a packing slip fastened to the outside of the crate.

3. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive DEP of other rights or remedies DEP may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other warranties made by Contractor under the Contract Documents. Obligations of Contractor under the Contract Documents shall not be limited in any way by provisions of specified special warranty.

B. Special Warranty on Materials and Equipment:

1. Provide manufacturer's written warranty, running to the benefit of DEP, agreeing to correct or, at option of DEP, remove and replace, materials and equipment specified in this Section found to be defective during period of 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. A qualified, factory trained representative shall be provided for installation supervision, start-up and test services, and operation and maintenance personnel training services. The manufacturer's representative shall make a minimum of two visits to the Site as described below. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

1. Second visit shall be for checking completed installation, start-up of system, and performing field quality control testing. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Minimum number of hours on-Site: 16 hours, no more than 8 hours per day.

2. Third visit shall be for instructing operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 05 – Equipment Start-up and Training.

B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to DEP.

2.02 MATERIALS / EQUIPMENT

A. System Description:

1. Bridge crane and hoisting equipment shall be of the top-running, double girder, and low headroom type with hoist nested in trolley to provide maximum clearance over the operating floor. Bridge crane and hoisting equipment shall conform to maximum lift elevation, limits of hook travel, runway locations, and side clearance requirements shown and indicated in the Contract Documents, and shall provide required available lift height and capacity.

B. Area Classification:

1. Bridge crane and hoisting equipment and appurtenances shall be suitable for installation in the specified NEC Hazardous Classification as indicated on the Drawings.

2. Electric motors and components suitable for operation in Class 1, Division I, Group D environments shall be rated explosion-proof. Exposed mechanical equipment suitable for operation in Class 1, Division I, Group D environments shall be non-sparking.

C. Performance Criteria:

1. Equipment description: Bridge crane, runway beams, electric trolley, and electric wire rope hoist.
2. Bridge Type: Top-running, double girder, motorized, two speed.
3. Hoist Type: Nested, low headroom, wire rope, double reeved, true vertical lift, motorized, two speed hoist.
4. Trolley Type: Top-running, double girder with a nested hoist.
5. Service Classification: Infrequent use.
6. Rated Capacity: 5 tons.
7. Runway Beam Length: As shown on the Contract Drawings.
8. Bridge Span: As shown on the Contract Drawings. End Truck Wheelbase: As shown on the Contract Drawings
9. Maximum Lift: 54 feet
10. Operating Floor Elevation: 13.5 feet
11. Minimum Rated Hook Lift: 5 tons
12. Nominal Operating Speeds:
    a. Bridge: 27/9 feet per minute.
    b. Trolley: 651/21.7 feet per minute.
    c. Hoist: 15/5 feet per minute 2-speed
13. Electric Motors:
    a. Bridge Motor:
        1) Rated Horsepower: 5 Hp.
        2) Rated Voltage: 460 VAC, 3 phase.
    b. Trolley Motor:
        1) Rated Horsepower: 1/2 Hp.
        2) Rated Voltage: 460 VAC, 3 phase.
    c. Hoist Motor:
        1) Rated Horsepower: 10 Hp.
        2) Rated Voltage: 460 VAC, 3 phase.
14. Electrification System: Festooned cable.

15. Controls: Pendant control.
16. Crane Manufacturer:
    a. Dearborn Crane.
    b. Engineered Material Handling.
    c. Sissco Material Handling
    d. Or approved equal.
17. Trolley Manufacturer:
    a. Dearborn Crane.
    b. Engineered Material Handling.
    c. Sissco Material Handling
    d. Or approved equal.
18. Hoist Manufacturer:
    a. Dearborn Crane.
    b. Engineered Material Handling.
    c. Sissco Material Handling.
    d. Or approved equal.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. General:

1. All equipment of structural steel construction shall be in accordance with AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings".
2. Crane structural design shall be in accordance with the latest revision of CMAA 70.
3. Castings, forgings and stampings shall be designed with an allowable stress not to exceed 20 percent of the ultimate strength of the material.
4. All shop welding shall conform to the requirements of AWS D14.1. Field welding of equipment shall be in accordance with manufacturer's written instructions. Field welding to the building structure shall be in accordance with AWS D1.1/D1.1M.
5. The rated load of the bridge crane and hoisting equipment shall be plainly marked on each side of the bridges and load blocks. Markings shall be clearly legible from the loading position.
6. Provide special consideration to available headroom and vertical clearance.
7. Provide crane with configuration and weights that do not result in a load exceeding the design capacity of the runway beams.

8. An impact allowance shall be included in design calculations for trolley, bridge, and runway beams. The impact allowance shall be 1/2 percent of the rated load for each foot per minute of hoisting speed with a minimum allowance of 15 percent and a maximum of 50 percent.

9. Safety requirements of ANSI B30.11 shall be incorporated in all equipment furnished.

B. Runway Beams:

1. Runway Beams: ASTM A36, structural steel.

2. Maximum Deflection: 1/888 inches of span.

3. Provide cushioned hard rubber stops on the ends of runway beams.

4. Existing Support Spacing: As shown on the Contract Drawings.

5. Existing Support Type: As shown on the Contract Drawings.

C. Crane Bridge:

1. Bridge Girders: ASTM A 36/A 36M, structural steel.

2. Maximum Deflection: CMAA 70.

3. Replace cushioned hard rubber stops on ends of bridge girders.

D. Bridge Truck Wheel Bearings:

1. Bridge truck wheel bearings shall be replaced.

2. Combination radial and thrust bearings, precision type, pre-lubricated and sealed or provided with fittings and seals for pressure lubrication.

3. Bearing Life: B-10 life of 100,000 hours based on 75 percent of the wheel load, and the full rated speed of the propelled carriers.

E. Bridge Crane Drive:

1. The bridge drive shall be designed to replace only the portion of the drive shaft where the new drive is to be mounted. The drive shaft shall be supported on lubricated ABEC 1 ball bearing pillow blocks based on 10 ft maximum centers. The pillow block shall be lubricated through pressure grease fittings. The crane drive shaft shall be steel and designed to limit torsional stress to 6000 psi. Maximum torsional twist angle in the drive shaft shall not exceed one degree of the wheel rotation under maximum rated load, regardless of load location. Provide new shaft couplings where the new shaft meets the existing.

   a. Comply with Section 26 05 91 – Low-Voltage Electric Motors, including requirements for source quality control and field quality control.

b. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation.

c. All wiring and equipment shall comply with the provisions of Article 610, Cranes and Hoists of the National Electrical Code, NFPA 70.

d. Motors: Suitable for crane and hoist service and rated on not less than a 30 minute basis with temperature rise in accordance with NEMA standards.

1) Bridge Crane Motor: TENV, squirrel cage, Class B insulation, 55°C temperature rise, high slip, and high torque. Bridge Crane motor operating speeds shall be as indicated in Paragraph 2.1.

2) Provide dual drives.

F. Electrically Operated Trolley and Hoist:

1. Trolley wheel bearings shall be replaced. Each wheel shall be supported by two tapered roller bearings provided with a suitable grease reservoir to eliminate the need for field lubrication between schedule maintenance periods. Grease fittings shall be provided.

2. The hoist including hoist drum, hoisting rope, load blocks, hook and limit switches shall be replaced.

3. Load Block: Load block shall be enclosed type and shall be constructed to prevent rope jamming. Lower block frame shall be bronze. Lower block side plates shall be aluminum.

4. Hook: Latch-type hook shall be used, and shall be free to rotate through 360 degrees under all loading conditions. Hook shall be solid bronze with stainless steel latch.

5. Hoisting Rope: The rated load divided by the number of parts of the rope shall not exceed 20 percent of the nominal breaking strength of the rope. Rope ends shall be attached to hoist drum to prevent it from coming off the drum on full extension. The rope shall be spark resistant stainless steel wire rope.

6. Rope Sheaves: Sheave grooves shall be smoothly finished to a close formfitting saddle for the rope with the sides of the groove tapered outwardly. Running sheaves shall be provided with means for lubrication. Pitch diameter of running sheaves shall not be less than 16 times rope diameter and for non-running sheaves not less than 12 times rope diameter.

7. Drum: The rope drum diameter shall not be less than 40 times rope diameter. No less than one complete wrap of rope shall remain on the drum after its full rated extension.

8. Gearing: Hoist gearbox shall be in accordance with the standards of AGMA. The gearbox shall include hardened and ground internal reduction gears which shall drive an external drum gear located on the inner surface of the rope drum. The gearbox shall be of the semi-fluid grease lubricated type to ensure adequate lubrication of all gearing.
9. Bearings: All bearings shall be permanently-lubricated type.
10. Brakes: The hoist shall have two sealed, dust proof breaks; a trolley break and a hoist motor break. Each shall be capable of supporting and holding 125 percent of the full rated load without power. Load brake shall be mechanical type.
11. Trolley Bumper: Rubber bumper shall be replaced.
12. Hoist Motor:
    a. Comply with Section 26 05 91 – Low-Voltage Electric Motors, including requirements for source quality control and field quality control.
    b. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation.
    c. Motor shall be of the two-speed, totally-enclosed, thermally protected, dual wound squirrel-cage, induction type, with anti-friction bearings and Class "F" insulation, designed specifically for reversing and hoisting service.
    d. Motor shall be reversible, with torque characteristics suitable for the hoist service and capable of operating at specified loads.
    e. Motor at rated frequency shall be capable of operation at plus ten percent of rated motor voltage.
13. Trolley Motor:
    a. Comply with Section 26 05 91 – Low-Voltage Electric Motors, including requirements for source quality control and field quality control.
    b. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation.
    c. Motor shall be of the stepless, totally enclosed, thermally protected type, designed specifically for reversing and hoisting service.
14. Provide supports, fasteners, brackets and all accessories required for the hoist and trolley.

G. Surface Preparation and Painting:

1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machined surfaces.
2. Clean and apply in the shop prime coat in accordance with Section 09 91 00 – Painting.
3. Apply in the shop finish coat in accordance with Section 09 91 00 – Painting.
4. The entire existing crane structural members shall be provided with new paint coating in the field.
5. Gears, bearing surfaces, and other machined surfaces shall receive a heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is placed into operation.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Hoist Speed Control:

1. Hoist motor shall be two-speed, as specified in this Section, with magnetic control.
2. The magnetic control shall have contactors sized for specified class of service. Reversing contactors shall be mechanically and electrically interlocked to prevent line-to-line faults, and shall be provided with automatic reset thermal overloads for hoist motor.

B. Control Station:

1. Control station shall be rated in accordance with Article 2.1.B of this Section. Motion control pushbuttons shall spring return to "Off" position when released. Function of each pushbutton shall be clearly marked and indicate direction of resultant motion.
    a. Control station shall contain the following functions:
        1) "POWER ON"
        2) "POWER OFF"
        3) "HOIST UP"
        4) "HOIST DOWN"
        5) "TROLLEY – FORWARD"
        6) "TROLLEY – REVERSE"
        7) "BRIDGE – FORWARD"
        8) "BRIDGE – REVERSE"
2. Pendant Control:

a. Control of hoist and trolley shall be by pendant pushbutton control station.

b. Pendant mounting shall include steel cable to provide strain relief for pendant's electric control cable. Provide isolating transformer to reduce voltage to 120 volts (or less) in control circuits. Pendant shall be located 3 feet above operating floor elevation.

c. Pendant shall be intrinsically safe.

C. Electrification:

1. Contractor shall provide an electrification system for the electrically operated bridge crane and hoisting system.

2. Festooned Cable System:

a. Contractor shall provide and install festooned cable type electrification for the crane, trolley and hoist. The festooned cable systems shall be mounted parallel to the crane runway and bridge girders. Where indicated on the Drawings, festooning system shall be on the side of the runway beams shown.

b. Conductors shall be sized suitable for power, control and grounding, carrying the required current to all connected motors when operated at rated conditions. Provide 30 ampere minimum rated power conductors.

c. Special consideration to clearance, headroom and hook approach requirements shall be given in designing the layout of the festooned cable system. System layout shall permit full travel of crane and hoist equipment along the entire length of the crane runway.

d. A minimum of 8 feet clearance shall be maintained between the bottom of the cable loop and operating floor unless otherwise shown on the Drawings.

e. Loop depth shall not exceed 2.5 feet.

f. Provide a cable length equal to 110 percent of the required length in order to avoid overstressing.

g. Provide all wire, cable, connectors, supports, special tooling and incidentals as required for power and control hookups on the load side of the manual safety switch.

D. Identification:

1. Identify component subassemblies with stainless steel nameplates and each labeled with the following:

a. Manufacturer and model number.

b. Date of manufacture with pertinent ratings, operation, and maintenance information.

c. Certification, stamp, or approval to applicable codes.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Inspect and verify that no part of the building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements that will interfere with proper operation of bridge crane and hoisting equipment along the entire length of both bridge crane runway beams.

3.02 IMPLEMENTATION

A. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the DEP's satisfaction.

B. Lubricate, adjust, test and leave crane in proper operating condition.

C. Install all power and control, conductors, wire, cables and connectors on the load side of the manual safety switch. Receive approval from Engineer, in writing, before wiring.

3.03 FIELD TESTING / QUALITY CONTROL

A. Site Tests:

1. After installing equipment and associated controls, perform at the Site running tests for bridge crane and hoisting equipment and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing and adjusting until, in Engineer's opinion, installation is complete and equipment is functioning properly and accurately, and is Substantially Complete.

2. Load Test:

a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of Engineer.

b. Weights used in load testing shall be certified by a state or local bureau of weights and measures. Submit weight certification as part of the load test report.

c. Load testing shall conform to ASME B30.11, ASME B30.16, and the following:

1) For electric hoists, power failure test with rated load: Load shall be held suspended when power is removed.

2) Bridge crane travel full length of runway beams and trolley travel full length of bridge crane girders with rated load, while verifying that all functions operate properly.

3) Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured. Criteria for Acceptance: No difference in measurements.

4) Upper/lower limit switch test with no load.

5) Emergency stop test with no load.

6) Deflection Test: With hoist positioned at center of bridge span, and at center of longest runway beam span), while hoisting rated load, measure distance from hook to floor. Remove load and measure distance from hook to floor. Criteria for Acceptance: Difference in measurements shall conform to 1/888 inches of span. Deflection test shall be done prior to load test and shall be done with a load equal to 100% of rated capacity.

d. Load Test Report: Submit results of load testing as report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.

3.04 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all monorail hoisting equipment, complete and operational, including but not limited to: monorails, trolleys, hoists.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	6
2.04	Source Quality Control / Shop Tests	7
PART 3	EXECUTION	7
3.01	Examination / Preparation	7
3.02	Installation	7
3.03	Field Testing / Quality Control	7
3.04	Startup / Demonstration	8
3.05	Adjusting / Protection / Cleanup	9

C. The following schedules, attached after the “End of Section” designation, are a part of this Section:

1. Schedule 41 22 33.19-1, Manual Monorail Hoist Requirements.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.02 – Miscellaneous Metal Fastenings

B. Section 09 91 00 – Painting

C. Section 40 05 97 – Identification for Process Equipment

1.04 REFERENCES

A. Definitions:

1. HMI: Hoist Manufacturers Institute
2. MMA: Monorail Manufacturers Association
3. UL: Underwriters Laboratories

B. Reference Standards:

1.	AGMA	American Gear Manufacturers Association
2.	ASME B30.11	Monorails and Underhung Cranes
3.	ASME B30.16	Overhead Hoists (Underhung)
4.	CMAA	Crane Manufacturer's Association of America
5.	NACM	National Association of Chain Manufacturers
6.	NYCBC	New York City Building Code

1.05 DESCRIPTION

A. The hoisting equipment systems shall consist essentially of gear chain hoist and trolley.

1. All equipment furnished under this Section shall be from a single hoisting equipment manufacturer or supplier.

B. The hoisting equipment manufacturer shall design, furnish, shop test, and supervise the installation of the equipment as required for safe, trouble-free operation.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall be a member of the HMI and the MMA, or approved equal.

a. Submit proof of membership, or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of Engineer.

2. The manufacturer shall have a minimum of five (5) years experience in the design and manufacture of equipment of the specified size and type.

B. Equipment furnished under this Section shall be a standard product of the manufacturer and shall conform to all recommendations of the HMI, unless otherwise specified.

C. All equipment provided under this Section shall be obtained from a supplier or manufacturer who shall assume full responsibility for the completeness of the system.

1. The supplier shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

1.07 SUBMITTALS

A. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Proof of membership in the HMI and MMA, or demonstration that the standards and experience required for membership are possessed.

b. Equipment specifications and data sheets identifying all operating information, materials used, and methods of fabrication.

c. Complete assembly, layout, and installation drawings with clearly marked dimensions, and bolting, requirements.

d. Weights of all component parts and assembled unit weights.

e. Operating loads.

f. Example equipment nameplate data sheet.

g. List of recommended lubricants and lubricant specifications.

h. Shop and field testing procedures.

i. Deviations from the Contract Documents.

j. Description of control system.

k. Operation and Maintenance Manuals in accordance with the requirements of the Contract Documents.

2. Information Submittals:

a. Recommended spare parts other than those specified.

b. Recommendations for short and long term storage.

c. Reports:

1) All shop test and field test reports and certificates.

2) All manufacturer's Site visit reports.

d. The manufacturer's instructions on installation procedures.

e. Calculations for sizing of all beams including supports, sealed and signed by a New York registered Professional Engineer.

f. Certification by a registered Professional Engineer stating that the design the system conforms to the applicable standards and codes and is as specified.

g. Approximate shipping weights.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Deliver materials to the site to ensure uninterrupted progress of the Work.

2. Major structural components shall be prepared for shipment in accordance with the carrier's specifications.

3. All skids, carriers, and pallets shall be enclosed in water-tight plastic wrapping, 6 mil minimum thickness.

4. Master shipping list shall be supplied showing the quantity of each section, subassembly, or piece, the piece number and the drawing on which each subassembly or piece is detailed.

B. Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. All equipment shall be prominently marked for identification in assembly:

a. The part identification shall be stenciled conspicuously on large pieces of equipment.

b. Small parts shall have a metal tag wired in place with identification stamped or etched.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Contractor shall provide spare parts and special tools necessary to service, disassemble, repair and adjust the equipment provided under this Section, and as per the requirements of the Contract Documents.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hoists and Trolleys:

1. Yale Hoists, as manufactured by Columbus McKinnon Corp., Getzville NY.

2. ACCO Material Handling Solutions, York, PA.

3. Morris Material Handling, Inc., Boyertown, PA.
4. Sissco Hoist & Crane, Division of Permadur Industries, Inc., Hillsborough, NJ.
5. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. Hoisting equipment shall comply with the safety and specification standards of ASME B30.11, ASME B30.16, and ASME HST-4.
2. Hoists and trolleys shall be specially designed, constructed and installed for the service intended. All features necessary for satisfactory operation and functioning of the hoisting equipment shall be provided, whether or not they are described in these Sections. Hoists and trolleys shall meet the specific requirements of Schedules 41 22 23.19-1 located after the "End of Section" designation.
3. All parts of the mechanisms shall be amply designed and constructed for the maximum stresses occurring during fabrication, installation and continuous operation. All materials shall be new. All parts of duplicate equipment shall be interchangeable without modification, and all parts subject to wear shall be of standard pattern and easily replaceable without the necessity of special cutting and fitting.
4. The equipment shall be designed and manufactured in accordance with the codes and standards listed herein. They shall be considered an integral part of this Section and shall govern the design, fabrication, testing and inspection of equipment, except as otherwise shown or specified herein.
    a. Gearing:
        1) Type: Helical gears
        2) AGMA Quality: 9 or better.
        3) Provide gears hobbed and ground smooth.
    b. Shafts: Alloy steel
    c. Bearings: Antifriction type with a minimum L-10 life of 5,000 hours, lifetime pre-lubricated and sealed.

B. Monorails:

1. The existing monorail beam shall be reused as shown on the Contract Drawings. The system shall be tested to accommodate a new manual chain hoist and trolley. Components included but not limited to:
    a. Load test according to ASME B30.11 and ASME B30.16.
    b. Capacity labels based on load test.

C. Manual Chain Hoists And Trolleys:

1. Hoist Drive: Chain hoist shall be driven through gear trains with all operating parts totally enclosed. Gears shall be carried on anti-friction bearings and operate in an oil bath or with grease lubrication.

2. Hoist Brake: Provide a mechanical brake rated for 250 percent of load.

3. Hoisting Chain (Load Chain): Hoisting or load chain shall be steel chain, accurately pitched to pass smoothly over all load sprockets without binding. Chain shall meet all requirements of the NACM Grade 100. Chain shall be coated by hot dip galvanizing. Remove excess metal at welded chain joints for proper fit into the chainwheel pockets. Remove burrs and sharp edges. Chain shall be suitable for bare-hand operation.

    a. Proof Test: Provide load chains which have been proof tested by the chain or hoist manufacturer with a load equivalent to at least one and one half times the rated load of the hoist divided by the number of chain parts supporting the load.

4. Operating Wheels and Chains: Provide operating wheels equipped with swinging chain guides to permit rapid handling of the operating chain without gagging the wheel and to permit a reasonable side pull on the chain. Operating chains shall hang 3 feet above the operating floor.

    a. Electroplating: Operating wheels, guides and chain shall be electroplated with zinc.

5. Trolleys: Trolleys shall be gear chain driven.

6. Appurtenances: Provide chain guides, guards and chain storage container attached to the hoist and/or trolley.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Anchorage Devices:

1. Provide fasteners in accordance with Section 05 05 23.02 – Miscellaneous Metal Fastenings and as shown on the Contract Drawings.

B. Identification:

1. Each unit of hoisting equipment and monorail shall bear an inscription, easily readable from the operating floor, showing the rated capacity of the equipment (in tons) and control identification.

2. Provide brass or stainless steel nameplates for all systems and component subassemblies in accordance with Section 40 05 97 – Identification for Process Equipment. Include, at a minimum, the following information:

    a. Manufacturer and model number.

    b. Date of manufacture with all pertinent ratings and operation information.

    c. Certification stamp or label for all applicable codes.

C. Health and Safety: Provide all appurtenances, caution markers, and appliances necessary to satisfy applicable safety laws and codes shall be provided.

D. Shop Painting:

1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00 – Painting.

2. Finish paint ferrous metal surfaces in the shop using the manufacturer's approved standard finish system. Finish system shall be compatible with the primer specified in Section 09 91 00 – Painting and herein in this Section.

3. Coat machined, polished, and non-ferrous metal surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

4. Stainless Steel: Do not paint stainless steel.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Certified shop test the hoisting equipment for static and dynamic loads in accordance with manufacturer's approved testing protocol.

B. Shop tests shall be performed in accordance with the requirements of ASME B30.11.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install monorail hoist equipment in complete accordance with the manufacturer's printed instructions and the approved Shop Drawings.

B. Provide all required lubricants for initial operation.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition:

1. Contractor shall verify that all work furnished and installed conforms to the requirements the Contract Documents.

2. Reports: Submit a report from the manufacturer of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

B. Preliminary Field Test:

1. After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a running test of the hoist in the presence of Engineer to demonstrate that the hoist will function correctly, meaning that the trolley travels along the monorail and the hook moves up and down without binding.

C. Final Field Tests: After successful completion of the preliminary field tests, perform load tests in accordance with CMAA standards and the NYC Building Code requirements.

1. Contractor shall provide all necessary instruments, labor, tools, and materials to conduct the field tests.

D. In the event that the Contractor is unable to demonstrate that the equipment meets the requirements of the above described field tests, the deficient equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements.

E. At a minimum, the services of the manufacturer's representative shall be provided as indicated, below. The number of visits and person-days per visit, indicated below, shall be understood as referring to the total required services for the lot of equipment provided under this Section.

Visit:	Purpose:	No. of Visits:	Person-days per visit:
1	Installation Checkout	1	1
2	Field Testing	1	1

3.04 STARTUP / DEMONSTRATION

A. Furnish the service of a qualified manufacturer representative to assist in the start-up of the equipment and train the plant operations and maintenance staff in the care, operation, and maintenance of the equipment in accordance with the requirements of the Contract Documents. In addition:

1. Contractor shall make all adjustments required to place Work in proper operating condition.

2. Contractor shall include in training of plant personnel instruction on care and maintenance of the materials and equipment.

3. In the event of trouble with the equipment during startup / initial operation, the manufacturer's representative shall revisit the site as often as required until all troubles are corrected and the installation is entirely satisfactory.

B. At a minimum, the services of the manufacturer's representative shall be provided as indicated, below. The number of visits and person-days per visit indicated,

below, shall be understood as referring to the total required services for the lot of equipment provided under this Section.

Visit:	Purpose:	No. of Visits:	Person-days per visit:
3	Startup / Initial Operation	1	1
4	Training	1	1

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting of scratched or damaged surfaces, using primer, intermediate and finish paints provided by the manufacturer, in accordance with the requirements of this Section and Section 09 91 00 – Painting.

END OF SECTION

NO TEXT ON THIS PAGE

SCHEDULE 41 22 23.19-1
MANUAL MONORAIL HOIST REQUIREMENTS

Location:	South Entrance Loading Dock
Top of Monorail El.: (ft)	Verify in field
Quantity:	1
Lift Capacity: (tons)	2
Area Classification:	Outdoor
Hoist Mounting:	Standard
Maximum Lift: (ft)	N/A
Radius: (ft)	NA
Load Chain Material:	Type 316 stainless steel
Hand Chain Material:	Type 316 stainless steel

NO TEXT ON THIS PAGE

SECTION 43 05 21 – COMMON WORK RESULTS FOR PUMPING UNITS
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified and required, to furnish, install, and test all Pumping Units, completely and operationally.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	5
1.08	Delivery, Storage, and Handling	10
1.09	Spare Parts, Special Tools, and Supplies	10
1.10	Warranty	11
PART 2	PRODUCTS	11
2.01	Manufacturers	11
2.02	Materials / Equipment	12
2.03	Fabrication / Assembling / Finishes	14
2.04	Source Quality Control / Shop Tests	15
PART 3	EXECUTION	18
3.01	Examination / Preparation	18
3.02	Installation	19
3.03	Field Testing / Quality Control	21
3.04	Startup / Demonstration	24
3.05	Adjusting / Protection / Cleanup	24

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 15 – Witness Shop Testing

B. Section 01 75 10 – Preliminary and Final Field Tests

C. Section 05 05 23.02 – Miscellaneous Metal Fastenings

D. Section 09 91 00 – Painting

E. Section 26 05 91 – Low-Voltage Electric Motors

F. Section 40 05 05 – Exposed Piping Installation

G. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping

H. Section 40 05 15 – Copper and Brass Process Pipe

I. Section 40 05 19 – Ductile Iron Process Pipe

J. Section 40 05 56 – Process Valves, Smaller than Four-Inch Diameter

K. Section 40 05 97 – Identification for Process Equipment

L. Section 40 70 01 – Measurement

1.04 REFERENCES

A. Definitions

1.	Pumping Unit:	A pump, complete with (but not limited to): drive motor, base, connecting shafting, bearings, belts, gear reducing units, couplings, seals, machine guards, sensors, accessories, appurtenances, and all associated equipment necessary and required for a fully functional unit.

B. Reference Standards

1.	ANSI/ASME B16.1	Standard Specification for Cast Iron Pipe Flanges and Flanged Fittings
2.	ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch).
3.	ANSI B11.19	Performance Criteria for Safeguarding.
4.	ANSI S2.41	Mechanical Vibration of Large Rotating Machines with Speed Range from 10 to 200 Rev/s - Measurement and Evaluation of Mechanical Vibration Severity In-situ.
5.	ANSI/HI 11.6	Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
6.	ANSI/HI 14.6	American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
7.	ANSI Z535	Safety Alerting Standards.
8.	OSHA 1910.219	Machinery and Machine Guarding.

SECTION 43 05 21 – COMMON WORK RESULTS FOR PUMPING UNITS
CONTRACT PS-318

1.05 DESCRIPTION

A. The scope of this Section includes requirements common to all Pumping Units, except where requirements for Pumping Units are shown or specified elsewhere in the Contract Documents. In addition:

1. Each Pumping Unit shall be furnished complete with drive motor and all other components necessary and required for a complete and operational unit.

2. The Contractor shall be entirely responsible for the compatibility between all components of the Pumping Unit(s) furnished.

3. If the Pumping Unit requirements of this Section and Pumping Unit requirements specified elsewhere are in conflict, the more stringent provision shall apply.

B. Coordination of Pumping Units with Contract Drawings:

1. The Contract Drawings only show a general arrangement of Pumping Units, unless otherwise indicated.

a. Pumping Units shown are generic and do not necessarily reflect the details of any Pumping Unit manufacturer.

b. Structural supports, foundations, equipment pads, as well as connected piping and/or valves, in part or in whole, may have to be modified from the arrangement(s) shown, in order to accommodate the specific Pumping Unit(s) furnished.

c. The Contractor shall be responsible for identifying any and all modifications to the design required by the Pumping Unit(s) furnished, and submitting those modifications to the Engineer as specified herein.

d. The pump suction and discharge nozzles shown (or, if not shown, as indicated by the connected pipe size shown) on the Contract Drawings shall be considered minimum sizes, unless otherwise specified.

C. The electric motor furnished with each Pumping Unit shall comply with the requirements of Section 26 05 91 – Low-Voltage Electric Motors.

1.06 QUALITY ASSURANCE

A. Qualifications of Manufacturer:

1. All Pumping Units shall be of approved design and make and products of manufacturers who have built equipment of similar type, size, and capacity for at least ten (10) years.

a. The manufacturer shall have, in the opinion of the Engineer, sufficient experimental and test data to cover the design of the equipment specified.

2. All Pumping Units shall be of manufacturers who possess at least two (2) installations that were designed in accordance with United States industrial standards (ANSI, ASTM, ASME, etc.), and are of design, capacity, and service similar to the equipment proposed to be furnished. Both these installations shall have been in continuous, successful operation for a period of at least four (4) years.

3. All Pumping Units shall be the products of manufacturers who can produce evidence of their ability to promptly furnish any and all interchangeable replacement parts as such may be needed at any time within the expected life of the pumps.

4. All Pumping Units shall be of manufacturers in possession of a factory equipped with the necessary machinery, jigs, fixtures, and gages to assure the tolerances and finishes shown on the submitted Shop Drawings permit such interchangeability.

5. The pump manufacturer must possess, or have readily available, access to suitable testing facilities adequate for performing the shop tests required or specified and by the provisions of the Contract requirements.

   a. Testing facility shall be ISO certified.

6. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

B. Supply and Compatibility:

1. Traceability to original heat numbers shall be maintained for all major components including wear rings, shafts, shaft sleeves and impellers.

2. The equivalent parts of identical Pumping Units shall be inter-changeable.

   a. All parts and components of all Pumping Units shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.

C. Regulatory Requirements:

1. If the Pumping Unit requirements of this Section and referenced standards or manufacturer requirements are in conflict, the more stringent provision shall apply.

D. Quality Assurance inspections may be made by NYCDEP Bureau of Engineering Design and Construction, Quality Assurance Section, or its representative at the manufacturer’s facility.

1. Quality Assurance Inspections shall be in accordance with the requirements of the Contract Documents.
2. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication, so that QA inspection may be made.

E. QA inspections shall include, but not be limited to, the following activities:

1. Obtain representative material samples of main components.
2. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.
3. Perform visual and dimensional inspection of completed Work.
4. Testing of mechanical and chemical properties (sample(s) as required).
5. Witness surface preparation and coating and lining operations, paint peel tests, and holiday tests.
6. Witness any required hydrostatic, shop leakage and performance tests.
7. Perform ASTM A380 water test (Stainless steel).

1.07 SUBMITTALS

A. Coordination of Pumping Unit Submittals:

1. The Contractor shall submit Shop Drawings for each pump proposed within sixty (60) calendar days after receipt of a letter from the City approving the manufacturer.
2. Except for characteristic curves, all information required for each Pumping Unit (or group of identical Pumping Units) shall be submitted at one time.
    a. Partial submission of the following information will not be acted upon -- partial submissions shall be returned with a disposition of 'Rejected' for noncompliance with the requirements of the Contract Documents until the receipt of all required information has been submitted.
3. No pump will be deemed approved until all specified or requested information thereon is approved.
4. Pumping Unit submittals shall be submitted under the specification section number corresponding to the type of Pumping Unit.
5. Shop tests and Witness shop tests for Pumping Units.

B. Submittals shall comply with the requirements of the Contract Documents. In addition, submittals shall include, but not be limited to:

1. Action Submittals:
    a. Quality Assurance Requirements:

1) The Contractor shall submit all information necessary and required to substantiate approval of a Pumping Unit manufacturer in accordance with the quality assurance requirements of this Section.

b. Schedule of deviations for all Pumping Units.

c. Characteristic Pump Curves:

1) Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, wire to water, efficiency and NPSH3.

a) For units of same size and type, provide curves for a single unit only.

2) The following characteristic curves shall be shown as ordinates, plotted against the rate of flow as abscissae, for the complete range of flow of the pump:

a) Outlet Total Head

b) Net Positive Suction Head *

c) Pump Power Output

d) Driver Power Input*

e) Pump Efficiency

f) Overall Efficiency *

g) Shut off head

h) Speed

3) Curves shall indicate Preferred Operating Region (POR) and Allowable Operating Region (AOR).

4) Characteristic curve values shall be defined as per ANSI/HI 14.6, regardless of type of Pumping Unit.

5) Curves shall be plotted in the following units:

a) Flow shall be in the flow units specified for the pump.

b) Head shall be in feet.

c) Power shall be in horsepower

6) Curves not submitted in the correct units shall result in the entire submittal being rejected.

7) Each page of the characteristic curves shall include the Pumping Unit tag number(s).

8) A single set of characteristic pump curves may be submitted for identical Pumping Units.

a) All Pumping Unit tag numbers to which the set of characteristic curves belong shall be noted.

d. General Arrangement Drawings:

1) Pump tag number(s).

2) Connected piping and valves.

3) Pump drip and bearing cooling water drainage piping.

4) Electrical connections.

5) Starting, speed regulating, and protective equipment.

6) Auxiliary equipment.

e. Detail Drawings and Catalog Cuts:

1) Dimensioned assembly outline drawing(s) of the complete Pumping Unit, drive, and all associated equipment furnished.

a) Drawing(s) shall show plan, elevation and any other views or sections specified under the specification section corresponding to the type of Pumping Unit.

2) A dimensioned cross-sectional drawing of the assembled Pumping Unit.

a) Drawing shall show full details and associated materials of construction.

3) Submit detailed dimensioned drawings for all Pumping Unit base plates, subbases, and similar components, if furnished as part of the Pumping Unit, and as applicable.

4)

f. Foundation Bolt Drawings:

1) Drawings showing location, size, and full details of foundation bolts for all Pumping Unit components.

a) All weights and forces on foundation, motor support and bearing supports shall be clearly shown.

(1) Such forces shall be the maximum possible under any conditions (except those caused by water hammer in the connected piping).

(2) Such forces shall include hydraulic, static, and dynamic forces set up in any manner including the failure of any component or combination of components, such as impeller and shafting.

2) All additional drawings and information necessary and required for the final design of foundations and structural supports.

g. Detailed Drainage Piping Drawings:

1) All pump drip and bearing cooling water drainage piping Shop Drawings.

h. Motor Data:

1) Submit in accordance with the submittal requirements of Section 26 05 91 – Low-Voltage Electric Motors.

2) Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:

a) Speed-torque relationship.

b) Efficiency at ½, ¾, and full load.

c) Slip at full load.

d) Temperature rises and results of dielectric tests.

e) Bearing type and lubrication medium.

i. Test Reports:

1) In addition to the submittal requirements of the Contract Documents, submit the following test reports for all Pumping Units:

a) Test reports for all shop tests, regardless of whether said test was witnessed.

b) Electric motor shop tests in accordance with the requirements of Division 26, Electrical.

j. Spare Parts and Special Tools:

1) List of spare parts being furnished.

2) List of special tools being furnished.

k. Operation and Maintenance Manuals.

2. Information Submittals:

a. Quality Assurance:

1) Submit a signed statement from each manufacturer stating that all Pumping Units furnished comply with the quality assurance requirements specified herein.

b. Instruction Bulletins:

1) Submit six (6) bulletins giving complete instructions for installing, operating and dismantling all components of the Pumping Units shall be furnished.

c. Recommended Lubricants:

1) Submit list of recommended lubricants and quantities being furnished.

d. Contact Information:

1) Submit the following information on suppliers of all castings and other major components:

a) Name and address of the company.

b) Contact name.

c) Phone number.

e. Forge Lot Numbers:

1) Submit the lot number for pump parts which are shown, specified, and/or required to be forged.

f. Certified Material Test Reports:

1) Certified reports indicating physical, chemical, and mechanical properties, as well as heat treatment (as applicable), shall be furnished for the following parts:

a) Wear rings.

b) Shafts.

c) Shaft sleeves.

d) Impellers.

e) Cast iron parts, such as front and back heads, volutes, frames, covers, and bearing housings.

2) Certified material test reports on shafts shall indicate Jominy end-quench hardenability data.

3) Certified material test reports on impellers shall indicate tensile strength.

g. Description of Manufacturer's Testing Facilities:

1) Description shall include including hydraulic, mechanical, electrical, and instrumentation elements.

2) The description should cover initial and periodical calibration provisions for all instruments.

3) The descriptive matter shall contain illustrative photographs, drawings, and such other matter as may be required to demonstrate compliance with the Contract Documents.

h. For performance tests of centrifugal pumps that were not witnessed by DEP personnel:

1) A notarized certificate executed by a company official, stating that no contact between pump rings occurs over the full range of pump performance operation.

3. Closeout Submittals:

a. Manufacturer's Certification:

1) As a condition necessary to acceptance by the City of any Pumping Unit with a drive unit rated at five (5) horsepower or more, the Contractor shall deliver to the Engineer a certificate from the manufacturer, stating that:

a) The installation of the Pumping Unit is satisfactory.

b) Unit is ready for operation.

c) Operating personnel have been suitably instructed in the operation, lubrication and care of the unit.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish spare parts and special tools necessary to service, disassemble, repair, and adjust all Pumping Units, and as per the requirements of the Contract Documents. In addition, the Contractor shall furnish the following:

1. Spare Parts:

a. Spare pumps:

1) Two (2) uninstalled Main Sewage Pumps (MSPs).

2. Special Tools:

a. For each Pumping Unit, or for each group of identical Pumping Units, the Contractor shall furnish:

1) All special tools made specifically for the Pumping Unit.

2) Gages and fixtures which are required to operate, disassemble, and maintain each type of Pumping Unit.

b. All special tools shall be furnished in neat special steel cases fitted with locks and keys.

3. Supplies:

a. Where oil lubricated equipment is used, sufficient oil, of types approved by the equipment manufacturer, shall be supplied for one (1) year of operation.

b. For grease lubricated bearings sufficient grease shall be supplied for one year's operation.

B. The Contractor shall furnish spare parts for the Pumping Unit electric motors in accordance with the requirements of Section 26 05 91 – Low-Voltage Electric Motors based on the voltage of each Pumping Unit motor.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. General:

1. All related components for each Pumping Unit shall also be furnished by the corresponding manufacturer of that Pumping Unit.

2. Only standard parts of the specified manufacturer shall be used, unless otherwise approved by the Engineer.

3. Should any standard part fail to satisfy the requirements of the Contract Documents, with the explicit approval of the Engineer, the Contractor shall supply parts of approved special design to suit the requirements.

B. Threaded joints shall be made up with:

1. Permatex® joint compound, as manufactured by Permatex, Inc., Solon, OH.

2. Real-Tuff thread sealant, as manufactured by Hercules

3. Or approved equal.

C. Ball and Roller Bearings (if applicable):

1. ALEMITE Model No. 54278, as manufactured by SKF Group, Gothenburg, Sweden.
2. Lincoln Industrial Model No. 5580, as manufactured by SKF Group, Gothenburg, Sweden.
3. Or approved equal.

D. Button Head Grease Fittings (if applicable):

1. Alemite Model No. A-1184, as manufactured by SKF Group, Gothenburg, Sweden.
2. Lincoln Model No. 5700, as manufactured by SKF Group, Gothenburg, Sweden.
3. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. General:

1. All Pumping Units shall be designed and built for twenty-four (24) hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, without excessive vibration or strain, and requiring only that degree of maintenance generally accepted as normal with the specific type of pump required, unless otherwise specified in the Pumping Unit specification sections.

B. Material Compatibility:

1. All Pumping Unit materials shall be of a type and quality to withstand the hostile environment and stresses to which the Pumping Units and components may be subjected.

C. Connections:

1. Inlet and Discharge:
    a. Inlet and discharge connections shall be flanged or threaded, as shown or specified in the individual Pumping Unit specification section(s).
        1) For flanged openings: Flanges shall meet ANSI/ASME B16.1 Class 125 standards.
        2) For threaded openings: Threads shall meet American standard taper pipe threads complying with ANSI/ASME B1.20.1.
2. Harnessed flexible pipe couplings (or their approved equivalent) shall be provided along the inlet and discharge piping to each pump.

a. The Contractor shall install the harnessed flexible couplings in such a manner that the pump will be free from forces of consequential magnitude transmitted by the piping.

b. The Contractor shall provide the harnessed flexible couplings where shown on the Contract Documents.

c. The harnessed flexible couplings shall conform to the requirements of Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping.

D. Anchor Bolts:

1. All Pumping Unit anchor bolts shall comply with the requirements of Section 05 05 23.02 – Miscellaneous Metal Fastenings.

a. Pumping Unit anchor bolts shall be Type 316 stainless steel with nitronic-60 nuts, unless otherwise shown or specified in the Pumping Unit specification section(s).

b. Expansion bolts shall not be used, unless otherwise shown or specified in the Pumping Unit specification sections.

2. The Contractor shall furnish anchor bolts in conformance with the pump manufacturer's requirements and specifications, and shall install them in accordance with the manufacturer's instructions.

3. Concrete foundation anchor bolts shall be set in steel pipe sleeves for the full length of the bolts.

4. Approved special washers and nuts shall be furnished and installed on the lower ends of bolts unless pockets are provided for access to the nuts. Bolts or studs engaging tapped holes in pump components shall be of silicon bronze.

E. Drainage Piping:

1. Drainage piping shall be furnished for each Pumping Unit.

2. Exposed, non-concealed drainage piping shall be copper and comply with the requirements of Section 40 05 15 – Copper and Brass Process Pipe.

3. Drainage piping shall be of the minimum size specified and shall be provided with approved cleanout plugs.

4. Drip piping from pump to floor or floor drain shall include a plugged cross at the first drop and a screw union located between the cross and the pump.

5. Lubrication:

6. All oil pumps, oil or grease piping, oil tanks, oil filters, grease storage and grease feeding apparatus necessary for supplying lubrication to the Pumping Units shall be provided if necessary for a complete working installation.

7. Where water-cooled bearings are specified, an approved type of flow meter and a differential pressure switch shall be provided in the cooling water line. Pressure switches shall shut down the Pumping Unit in the event of low water flow.

8. All ball and roller bearings designed for grease lubrication shall be furnished with a safety vent type bushing of suitable size.

9. Ball and roller bearing lubricating greases shall be as recommended by the pump manufacturer.

F. Gages:

1. Gages shall comply with Section 40 70 01 – Measurement, unless otherwise specified.

2. All gages shall be graduated in feet of water for positive pressures, unless otherwise specified.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Identification:

1. Provide in accordance with Section 40 05 97 – Identification for Process Equipment.

2. Each unit of equipment shall be identified with the equipment item numbers shown on the Contract Drawings.

3. A corrosion resistant tag and nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

B. Pump Piping, Fittings and Valves:

1. Piping, fittings, and valves furnished with the Pumping Units shall comply with:

a. Section 40 05 06 – Couplings, Adapters, and Specials for Process Piping

b. Section 40 05 19 – Ductile Iron Process Pipe

c. Section 40 05 15 – Copper and Brass Process Pipe

d. Section 40 05 56 – Process Valves, Smaller than Four-Inch Diameter

C. Painting:

1. All work shall be painted in conformity with the requirements of Section 09 91 00 – Painting.

D. Direction of Rotation:

1. The direction of pump rotation shall be shown on the Pumping Unit.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Shop tests shall be performed and certified at the factory for all Pumping Units in accordance with the requirements of the Contract Documents and Section 01 43 15 – Witness Shop Testing or specified herein.

B. Witnessing of shop tests:

1. For all Pumping Units with a drive motor (or engine) rated at 125 hp or greater:

a. The following two (2) shop tests shall be witnessed by representatives of the DEP:

1) The hydrostatic shop test.

2) The performance shop test.

b. Additional shop tests specified herein shall be witnessed if required by the Pumping Unit specifications.

2. For all Pumping Units with a drive motor (or engine) rated less than 125 hp:

a. Shop tests shall be witnessed by representatives of the DEP if specified in the Pumping Unit specification sections:

3. Electric drive motors shall be shop tested as required by Section 26 05 91 – Low-Voltage Electric Motors .

C. Hydrostatic Shop Test:

1. General:

a. All Pumping Units shall undergo a certified hydrostatic shop test.

b. If required by the Pumping Unit specification sections, hydrostatic tests on pumps shall be made concurrently with the performance tests.

2. Test Procedure:

a. Test pressure:

1) For centrifugal, vortex, and turbine type Pumping Units: the test pressure shall be ≥ 150% of the shutoff head as shown on the approved characteristic curve. The test pressure shall be held for a duration of time according to ANSI/HI 14.6.

2) For positive displacement Pumping Units: The test pressure shall be ≥ 150% of the maximum head specified. The test pressure shall be held for a duration of time according to the applicable ANSI/HI standard governing that type of pump.

D. Performance Shop Tests:

1. General:
    a. All Pumping Units shall undergo a certified performance test.
        1) For all dry and wet pit submersible pumps:
            a) The performance shop test shall include (but not be limited to) testing the pump in the configuration shown on the Contract Drawings (i.e.., all dry pit submersible pumps shall be tested in dry pit, all wet pit submersible pumps shall be tested submerged.)
                (1) Wet pit submersible pumps shall be tested submerged in clean water.
        2) All performance shop tests shall be conducted at the point of manufacture for the pump, or a manufacturer testing facility within the same State, if domestic, or Country of Origin is nondomestic.
        3) Each performance test shall consist of a minimum number of points along the pump curve as specified in HI 9.6.4 for dry pit pumps.
    b. The performance shop test shall:
        1) Show that the pump has the general characteristics of head, efficiency, horsepower and such other properties as appear on the approved pump curves submittals.
        2) Prove the specified head, efficiencies, horsepower and other properties at the rating point.
        3) Establish that the pump is free from overheating, cavitation, and excessive vibration over the specified range of the rate of flow.
    c. Vibration displacement, velocity and/or acceleration readings shall be taken if specified or required at a witnessed test and the results shall be recorded. Tests at lower than maximum speed will not be required except for positive displacement plunger pumps, where runs at all speeds are required.
    d. All electrical starting and other control equipment necessary for testing shall be furnished by the pump manufacturer and shall be present at the test.
2. Procedure:
    a. For centrifugal pumps:

1) The Pumping Unit shall be run at normal rated speed over the specified range of flow and then held at shutoff head for at least 1 min.

b. For positive displacement pumps:

1) The Pumping Unit shall be run for at least 30 min at each speed and capacity specified.

2) During part of a run at maximum head and flow rate specified, a plug valve on the pump discharge shall be rapidly operated (opened and closed) manually several cycles without causing any damage to the pump as evidenced by a trouble free resumption of pumping at the same head and delivery.

c. For duplicate pumps with motors rated at < 5 hp:

1) Check tests against complete performance tests of pumps of exactly the same model, speed, head and capacity rating shall be acceptable.

3. Results:

a. For all centrifugal Pumping Units:

1) The Pumping Unit shall conform to the criteria of ANSI/HI 14.6 Acceptance Grade 1U for all applicable performance criteria specified. Pumping units that do not conform to Acceptance Grade 1U may be subjected to rejection by the Engineer.

2) At no point over the performance test range shall contact between the impeller ring and casing ring be permitted.

3) The manufacturer shall demonstrate evidence of no contact.

a) For witnessed performance tests:

(1) The manufacturer, immediately after the pump testing, shall have the pump disassembled and shall facilitate the visual inspection of the pump rings by the official witness.

b) For pumps which are not witnessed shop tested:

(1) The manufacturer shall submit, along with the shop test results, a notarized certificate executed by a company official, stating that no contact between pump rings occurs over the full range of pump performance operation.

4) Contact between the impeller and casing rings over the operating range shall constitute grounds for rejection of the pumps.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection:

1. The Contractor shall not install damaged items until repairs or replacements are made in accordance with manufacturer's written instructions and approval by Engineer.

a. Only minor repair work will be permitted in the field.

b. All damaged items requiring remedial work shall be returned to the manufacturer for repair or replacement at no additional cost to DEP.

B. Base Installation:

1. Equipment bases and grouting shall be installed as follows:

a. Leveling wedges or metal supports shall be installed beneath the base at each foundation bolt.

b. Grout allowance of ¾ to 1½ in. shall be provided between the base and the top of the foundation or equipment pad.

c. The Pumping Unit shall be aligned to the connecting piping.

d. Drive and driven equipment alignment shall be checked.

e. Piping shall not be connected until after the grout has cured.

f. Leveling wedges or metal supports shall be adjusted to level the unit.

g. Foundation bolts shall be tightened evenly but not too firmly.

h. Horizontal shaft units shall be leveled to within 0.005 in./ft and the driven equipment shaft of vertical units shall be plumb to within 0.002 in./ft.

i. Equipment bases shall be filled with grout. Grout shall be worked to release any entrained air in the grout or base cavities.

j. Foundation bolts shall be fully tightened only after the grout has cured.

C. Footing Adjustment:

1. The following procedure shall be used for any driver or driven equipment having four (4) or more individual support feet:

a. All mounting bolts shall be checked for tightness before proceeding.

b. A dial indicator shall be set on the equipment base next to the foot being checked.

c. The dial indicator on the foot being checked shall be zeroed.

d. The mounting bolt on the foot being checked shall be loosened and the indicator deflection shall be noted. A maximum deflection of 0.002 in. shall be permitted.

e. The mounting bolt shall be retightened and the procedure shall be repeated for all feet.

f. Any footing condition that exceeds the 0.002-in. limit shall be corrected.

1) The driver and driven equipment alignment shall be verified after making any corrections.

3.02 INSTALLATION

A. Install all Pumping Units in complete accordance with the manufacturer's printed instructions and the approved shop drawings.

B. Manufacturer's Representative during Installation

1. For all Pumping Units powered by drive units rated at ≥ 5 hp:

a. The Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment and field tests of each Pumping Unit and give instructions to designated DEP operating personnel.

b. The services of the manufacturer's representative shall be furnished for at least the number of days stipulated in the associated Pumping Unit Specification sections.

c. Should additional days of service be necessary for a successful installation, such services shall be provided by the Contractor at no additional cost to DEP.

2. For all Pumping Units powered by drive units rated at < 5 hp:

a. The Contractor shall furnish the services of accredited representatives of the pump manufacturer only when, in the opinion of the Engineer, there is some evident malfunction or over-heating.

C. Alignment of Pump Components and Pumping Units

1. Proper alignment of pump components and Pumping Units shall be maintained by shouldered fits of mating parts where such construction is at all possible and in accordance with best practice, or where the nature of such components obviates the use of shouldered fits, by dowels or turned bolts in reamed holes fitted after final alignment of parts is approved.

2. Assemblies of components for which alignment depends upon friction between mating parts or gaskets are unacceptable, except for the use of set screws, taper pins, certain screw threads and only those other elements for which specific approval is given by the Engineer or specified.

3. Shaft components transmitting torque from the shaft shall be keyed to the shaft.

    a. Set-screws or pins shall not be used in lieu of a key unless specifically approved by the Engineer.

4. Where the associated Pumping Units specification Sections identify model or catalog numbers for pumps, the equipment shall comply with the foregoing requirements of this Section, even though modifications of the manufacturer's standard product shall be necessary.

5. Sufficient metal shall be provided on all components for field dowelling or pinning, where such is specified after final field alignment.

6. Mating shafts on Pumping Unit components connected by couplings shall be aligned and the components shall then be dowelled or pinned.

    a. Alignment shall be made only after complete piping and electric conduit connections have been made and all required grouting has set.

    b. Alignment shall be made with an approved fixture which shall have two (2) components:

        1) Each component shall be securely clamped to one of the mating shaft ends.

        2) Two dial indicators shall be mounted on one of the two components.

            a) One dial indicator shall be so mounted as to indicate the parallel misalignment of the two shafts;

            b) the other dial indicator shall be so mounted as to give a measurable indication of angular misalignment.

    c. The Pumping Unit components shall be so adjusted and shimmed, that, before and after dowelling, the maximum variations in the reading of each of the two (2) dial indicators shall not exceed 0.001 in. per in. of minimum connected shaft diameter in one revolution of the coupling.

        1) Such alignment shall be demonstrated to the Engineer.

7. All shim stock used shall be of Type 316 stainless steel, unless otherwise shown or specified for specific Pumping Unit(s).

D. Drainage Piping Installation:

1. Drainage piping shall be installed and connected to each Pumping Unit, to convey the stuffing box or mechanical seal drippings and bearing cooling water to the nearest sump, gutter, floor drainage pipe or outlet.

    a. Such drainage piping shall be as shown, as specified, and/or as necessary and required to remove the drippings and/or cooling water from the Pumping Units without spilling on any floor area unless otherwise expressly stated or shown on the Contract Drawings.

2. Drainage piping shall be installed in accordance with the requirements of Section 40 05 05 – Exposed Piping Installation. In addition:

    a. Drainage piping from the pump to the point of disposal shall be run below the floor surface.

    b. Drainage piping shall not be run along the surface of a floor area, unless the space directly above or below the drainage piping is blocked by other piping shown on the Contract Drawings.

    c. For existing work and for new work where pump drainage piping was not installed before the floor structure was installed, chases shall be cut for the pump drainage piping and the floor finish shall be restored.

E. Piping and Equipment Identification

1. The Contractor shall furnish and install identification signs for all Pumping Units, valves and piping in accordance with the requirements of Section 40 05 97 – Identification for Process Equipment.

F. Refer to the associated Pumping Unit specification Sections for additional installation requirements.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation in accordance with the requirements of the Contract documents. In addition:

1. The Contractor shall verify that all work furnished and installed conforms to the requirements of the Contract Documents.

B. The Contractor shall provide the services of the manufacturer's representative at such times and for such durations of time as are needed to perform the tasks required of the representative.

1. The services of the manufacturer's representative shall be provided as indicated for each type of Pumping Unit as indicated in the associated Pumping Unit specification section(s).

2. The number of visits and person-days per visit indicated in the associated Pumping Unit specification section(s) shall be understood as referring to the

total required services for the lot of equipment provided under this Specification.

3. The Engineer reserves the right to require that any unused person-days from any visit be applied to any other specified visit.

4. Person-days shall be understood only as days spent on-Site (not in transit).

5. Unless otherwise authorized by Engineer, the manufacturer's representative shall be a direct employee of the equipment manufacturer, with at least three (3) years' experience in the installation, testing and startup of equipment of the type provided under this Section. The manufacturer's sales and marketing personnel will not be accepted as manufacturer's representatives.

6. The manufacturer's representative shall sign in and out at the office of the Engineer each day they are at the Site.

C. Field Performance Tests: Field testing shall be performed in accordance with the requirements of the Contract Documents and Section 01 75 10 – Preliminary and Final Field Tests or specified herein.

1. For centrifugal Pumping Units ≥ 5 hp:

a. Each Pumping Unit shall be run at maximum rated speed for at least three (3) rates of flow, corresponding to:

1) The specified minimum rate of flow;

2) The specified design or operating rate of flow, as directed by the Engineer; and

3) The specified maximum rate of flow.

b. Record the total dynamic head at each of the three rates of flow.

1) Total dynamic head shall be read from the pump pressure gages.

c. The flow rates shall be verified using a calibrated flow meter during the test.

1) If a flow meter is not installed or available for testing, the rate of flow shall be set by achieving the corresponding, specified total dynamic head.

2) Variation of the rate of flow shall be made by throttling the discharge valve.

d. Simultaneous ammeter readings shall be taken at each of the three flow rates.

1) The rated motor nameplate current and power shall not be exceeded at any rate of flow within the specified range.

2. Pumps with drive motors rated at less than five (5) horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.

D. Field Vibration Tests:

1. The vibration shall be measured for each and all Pumping Units across the full operating range specified in the associated Pumping Unit specification Section(s).

   a. Measurement of vibration for all Pumping Units shall be witnessed by the Engineer.

   b. The operating range shall exclude the shut-off point as specified in the associated Pumping Unit specification Section(s).

   c. Field vibration testing shall conform to HI Standard 9.6.4 for dry pit pumps.

2. Vibration measurements shall include overall unfiltered vibration amplitude and vibration signatures.

   a. The signatures shall be plots of filtered vibration velocity in in./s versus vibration frequency for a range of 100 to 60,000 cycles per min.

   b. For vertical Pumping Units supporting drive motors:

      1) Measurements need be taken only at:

         a) The lower pump bearings.

   c. For horizontal type Pumping Units:

      1) Measurements shall be taken at locations near:

         a) The two (2) motor bearings; and

         b) At the inboard pump bearing.

3. An approved type of instrument, calibrated by an approved laboratory just prior to and after the test, shall be used.

   a. Certification of such calibration shall be submitted to the City as part of the field testing submittal in accordance with the requirements of the Contract Documents.

4. Vibration in excess of ANSI HI Standards shall not be acceptable and shall be judged as presumptive evidence of defective construction, including but not limited to: unbalanced construction; flimsy construction of the base or mounting structure; and/or misalignment of parts of the Pumping Units.

   a. The Contractor shall take all measures to remedy the condition of excessive vibration to the satisfaction of the Engineer at no additional cost to the City.

1) The field vibration test shall be repeated after remedial measures are taken.

E. Refer to the associated Pumping Unit specifications for additional field testing requirements.

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting in accordance with the requirements of Section 09 91 00 – Painting.

B. Provide identification accordance with the requirements of Section 40 05 97 – Identification for Process Equipment.

END OF SECTION

SECTION 43 12 33 – RECIPROCATING AIR COMPRESSOR
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. This Section specifies the service air system for operation of air stations and pneumatic tool within the facility, complete with compressor, inlet filter, air receiver, aftercooler, automatic drain, motor, control panel, valves, gauges, and spare parts with all ancillary equipment as specified herein and shown on the Contract Drawings or required for a complete installation.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	2
1.05	Description	2
1.06	Quality Assurance	3
1.07	Submittals	3
1.08	Delivery, Storage, and Handling	4
1.09	Spare Parts, Special Tools, and Supplies	4
1.10	Warranty	4
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	5
2.03	Fabrication / Assembling / Finishes	9
2.04	Source Quality Control / Shop Tests	10
PART 3	EXECUTION	10
3.01	Examination / Preparation	10
3.02	Installation	11
3.03	Field Testing / Quality Control	11
3.04	Startup / Demonstration	12
3.05	Adjusting / Protection / Cleanup	12

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 15 – Witness Shop Testing

B. Section 01 65 00 – Product Delivery Requirements

C. Section 01 66 00 – Protection of Materials & Equipment

D. Section 01 75 10 – Preliminary and Final Tests

E. Section 01 79 05 – Equipment Start-up and Training

F. Section 09 91 00 – Painting

G. Section 26 05 91 – Low-Voltage Electric Motors

H. Section 26 29 13 – Enclosed Controllers

I. Section 40 05 97 – Identification for Process Equipment

J. Section 40 80 81 – PMCS Factory Testing

1.04 REFERENCES

A. This Section contains references to the following documents. They are a part of this Section, as specified and modified. In case of a conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

1. ASME Boiler and Pressure Vessel Code Section VIII
2. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies
3. NFPA 70 National Electrical Code (NEC)
4. NFPA 90 Electrical Standard for Industrial Machinery
5. ISO 1217 Displacement Compressors – Acceptance Tests
6. ISO 9001 Quality Management Systems

1.05 DESCRIPTION

A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, paint, shop test, deliver, install, adjust, field, test, and place in satisfactory operation the service air (air compressor) system complete and operational. Service air system shall be as specified herein and as shown on the Contract Drawings.

1. Electric motors furnished as part of the service air system, shall comply with the provisions of Section 26 05 91 – Low-Voltage Electric Motors unless otherwise specified.

1.06 QUALITY ASSURANCE

A. In accordance with the procedures and requirements set forth in the General Conditions of the Contract and Division 1, General requirements, the following provisions shall pertain to Work under this Section:

1. Manufacturer's Qualifications:

a. The Contractor shall provide evidence to the Engineer that the manufacturer has a minimum of five (5) years' experience, in the design, manufacture, and supervision of installation of equipment of the type required under this Section.

B. Quality Certification:

1. All manufacturers and manufacturing Sites proposed by the Contractor for supply of equipment furnished under this Section and Sections referencing this Section shall hold current certification under ISO 9001. Application for certification under ISO 9001 shall not be deemed as an acceptable substitute for current certification. Documentation attesting to current certification shall be signed by an officer of the manufacturer's corporation and shall be notarized. The documentation shall also include the manufacturer's written Quality Assurance/Quality Confirmation (QA/QC) program and the documentation plan necessary for ISO 9001 certification.

1.07 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions of the Contract and Division 1, General Requirements, the Contractor shall obtain from the equipment manufacturer and shall submit the following:

1. Working Drawings (see additional information below)
2. Operation and Maintenance Manuals
3. Lists of Spare Parts, Special Tools and Supplies
4. Reports of Certified Shop Tests
5. Reports of Field Tests and Start up
6. Reports of Manufacturer's Representative Site Visits

B. Working drawings shall include, but not be limited to, the following:

1. Manufacturer' equipment specifications and data sheets, with identification of all materials used and methods of fabrication.
2. Parts list with materials of construction.
3. Complete assembly, layout, installation, and shop drawings, with clearly marked dimensions, anchorage, and mounting details.
4. Equipment cross-section drawings.
5. Manufacturer's delivery, storage, and handling requirements.

6. Manufacturer's installation instructions and recommendations, including installation requirements requiring coordination with Contractor and/or other equipment suppliers.
7. Weights of equipment component parts, assembled weight of equipment, and total shipping weight.
8. Certification of manufacturing facility.
9. Painting and Coating details.
10. Equipment nameplate data.
11. Testing and adjusting instructions.
12. Electrical load calculations, rated power, rated input power.
13. Functional description of internal instrumentation.
14. Motor data as specified in Section 26 05 91 – Low-Voltage Electric Motors.
15. Equipment warranty information.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver, store, and handle the equipment and materials provided under this Section as specified in Section 01 65 00 – Product Delivery Requirements and Section 01 66 00 – Protection of Materials and Equipment.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall furnish and deliver to DEP, at that part of the Site and at such time as the Engineer may direct, the following spare parts for the compressor.
1. Two sets of compressor drive belts.
2. One intake filter.
3. One Primary/Secondary filter element.
4. Three (3) oil filters.
5. Any additional items the manufacturer recommends for spare parts during the first two (2) years of operation shall also be provided.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Compressed air system for permanent installation shall be as manufactured by one of the following:

1. Quincy, QR-25 Series, 701 N. Dobson Avenue, Bay Minette, AL 36507
2. Atlas-Copco LLC, 300 Technology Center Way Rock Hill, SC 29730
3. Ingersoll-Rand, 95 Newfield Ave, Edison, NJ 08837
4. Or approved equal

B. The components of the compressed air system shall be provided by the Contractor through one Vendor. The Contractor through the Vendor shall have the responsibility of matching all components and providing equipment which functions together as a system.

C. Supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions. Compressor unit and controls shall be provided by a single supplier who will take unit responsibility for the system.

2.02 MATERIALS / EQUIPMENT

A. The compressor shall be a packaged two stage, pressure lubricated type. The compressor shall be tank mounted and provided with an integral skid or lifting lugs for unloading and placement. Compressor shall be furnished complete with inlet filter, motor, belt drive, mounting base, safety valve, outlet valve, relief valve, gauge, vibration absorbers, and cooling system.

B. Air Compressor:

1. Air Compressor System Equipment Identification Number:
   a. 7400 - Air Compressor
   b. 7400A0 – Receiver Tank
2. Design and Performance Criteria: Each Compressor shall comply with the below listed performance criteria.

Location	Mechanical Equipment Room
Type	two stage reciprocating
Rated Flow (CFM)	15
Pressure (PSIG)	100
Cooling	Air Cooled
Lubrication	Oil pressure lubricating system
Startup	Automatic unloading during startup
Quantity of Receivers	1
Receiver Size	80 gallons
Receiver Rated Flow (SCFM)	15
Receiver Max. rated pressure (PSIG)	175

3. Additional Equipment Features:
   a. Frame

1) The cylinders and crankshaft with bearings shall be frame supported.

b. Crank Shaft

1) Crank shaft shall be one piece supported with two liberally sized heavy duty roller bearings. Crank shaft shall be balanced with counterweights over its entire length to minimize vibration

c. Cylinder.

1) The cylinder shall be closed grained cast iron. The cylinder shall be bolted to the compressor frame in a manner to allow for complete cooling. The cylinder shall be precision honed with the piston rings and shall employ deep radial fins for dissipation and removal of heat.

d. Head Unloader

1) The packaged compressor shall come complete with cylinder head unloader to bleed air from the cylinder upon stopping. This feature shall prevent the compressor from starting against a load

2) The air compressor shall have a spring-loaded minimum pressure check valve. The valve shall prevent backflow of air from the system piping.

e. Baseplate shall be constructed of one (1)-piece folded mild-steel with structural members and shall be designed for no measurable deflection with the equipment mounted thereon and the baseplate supported around its perimeter. The base shall be designed so that all equipment bolted to it can be removed without access to the underside of the plate and with a flat top surface for ease of cleaning. Structural stiffeners shall be located under the compressor at the compressor anchor points.

f. Valves shall be the compressor manufacturer's standard. Relief valves shall be provided for equipment protection on the air and coolant systems as required.

g. The compressor shall be provided with an integral, dry-type intake filter. Intake filter shall have a replaceable filter element rated for two thousand (2,000) hours minimum. Particle arrestance shall be not less than 99.9% efficient at three (3) microns and above.

h. The compressor shall be provided with a moisture separator rated for the compressor capacity and pressure. The separator shall be provided with an automatic float operated condensate drain trap.

i. Capable of operating continuously at one hundred four (104) degrees F at specified output without overheating.

4. Receiver:

a. Welded steel receiver bearing ASME code stamp.

b. Maximum Allowable Working Pressure: two hundred (200) psig.

c. Corrosion Allowance: one sixteenth (1/16) inch.

d. Safety relief valve (spring loaded).

e. Pressure gauge shall be 4-1/2 inch dial gauge with range from 0 to 160 psig, Bourdon tube sensing with pulsation damper and gauge isolation cock.

f. The receiver tank drain shall be a zero-loss, electronically operated drain valve, specially designed to drain condensate. It shall require a one hundred fifteen (115) V single phase power supply.

1) Operation: The condensate shall enter the Electric Water Drain (EWD) and accumulate in the collector. A capacitive sensor shall continuously measure the liquid level. As soon as the collector is filled up to a designated level, the pilot valve shall activate and the diaphragm shall open the outlet, discharging the condensate. Once the collector has been emptied, the outlet shall close quickly without wasting compressed air.

2) Alarm Mode: In case of a malfunction, the alarm LED shall start flashing and the voltage free contact shall activate. The electronic drain valve shall automatically change to the alarm mode, opening and closing the valve until the fault is remedied. Once the fault is cleared, the EWD shall automatically return to the normal mode of operation.

g. Automatic blowdown valve located at low point in receiver.

C. Sound Attenuation: The complete unit shall be constructed to limit the amount of noise to below all applicable safety regulations and shall not exceed eighty-five (85) dBA measured at a distance of three (3) feet from any component.

D. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over one hundred (100) pounds.

E. Accessories

1. Oil Removal Filters:

a. Manufacturers and Products:

1) Atlas Copco; UD+ Series

2) Wilkerson Corp.; M Series Coalescing Filter.

3) Champion; CFG Series.

F. Motors and Drives

1. Provide in accordance with Section 26 05 91 – Low-Voltage Electric Motors, unless otherwise specified herein.

2. Motor and drive shall be furnished by the equipment Supplier and shall be designed specifically for use with the equipment provided.

3. Motor Parameters

Motor Parameters	
Motor Tag Number	7400
Motor horsepower	5 HP
NEMA Design	N
Duty	Intermittent
Insulation	Class F
Voltage, Phase, and Hertz	460,3 Phase, 60 Hz
Service Factor	1.15
Motor Enclosure	TEFC
Protection	Thermocouples in bearings and windings

G. Controls

1. General:

a. All wiring, conduit and other electrical equipment shall conform to the requirements of Division 26.

b. Relay based control logic shall be provided for starting, operating and stopping the compressor.

2. Control Equipment – All electrical controls, devices, panels, and enclosures shall be in accordance with Section 26 29 13 – Enclosed Controllers and the related requirements of Division 40 Process Interconnection sections listed in Article 1.03 of this Section.

3. Compressor discharge pressure shall be set at a discharge pressure indicated in Article 2.02.B. This discharge pressure shall not be adjustable at the HMI and shall be password protected at the HMI to limit discharge pressures below one hundred (100) psi.

4. The system shall be fully automatic to maintain an adjustable pressure range in the receiver by cycling the compressor.

5. Provide an integral Control Panel to the compressor as specified in this Section. Control panel shall be NEMA 4 and shall be UL-508A approved. The control panel shall be supplied with one four hundred sixty (460) VAC, sixty (60) Hz, three (3)-phase power as shown; power supply shall be provided under Division 26. The control panel shall be provided with a

control power transformer to power the controls at one hundred twenty (120) VAC. Control panel shall be constructed in accordance with Divisions 26 and 40. The local control panel shall contain operator control devices, control relays, indicating lights and other panel devices as specified herein, Division 40, and as shown on the Contract Drawings. The control system shall be configured where upon loss of power and return of power the system shall return to the ready state. Combination motor starter, NEMA rated (NEMA Size 1 minimum), shall be supplied as part of the manufacturers control panel. Four hundred sixty (460) VAC power equipment shall be separated, using a painted metal barrier, from the one hundred twenty (120) VAC equipment.

6. The control system shall be provided by an Elektronikon MkV, or equal. The system should be capable of the following controls and constructed as required by herein and by Division 40.

   a. Controls:

      1) Compressor START / STOP
      2) RUN indication
      3) OFF indication
      4) FAULT indication
      5) Alarm reset
      6) LOW PRESSURE indication
      7) LOW OIL indication
      8) Status Contacts (Dry) for each of the following:
         a) Manual Load/Unload
         b) Warning Condition
         c) Shutdown Condition

   b. Automatic low oil pressure shutdown with oil pressure gauge.

   c. Pressure switches.

      1) System pressure indicator.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. The equipment provided under this Section shall be factory painted in accordance with the requirements of Section 09 91 00 – Painting and as recommended by the manufacturer.

B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. The Contractor shall provide corrosion-resistant nameplates, securely affixed in a conspicuous place, on each item of equipment. Nameplates shall conform to the requirements of Section 40 05 97 – Identification for Process Equipment and shall bear the manufacturer's name or trademark and such other information as is specified or deemed necessary by the manufacturer to complete the identification. Nameplate numbering shall be as specified or shown on the Contract Drawings.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Prior to shipment the compressor shall be operated to check alignment; faulty equipment and controls; proper wiring; leaks in piping, seals, or welds; and proper operation of the safety and operating controls. Compressor pressure controls shall be adjusted to the specified pressures. Defective equipment and controls disclosed by such tests shall be replaced and the package placed in satisfactory operating condition before shipping.

B. Certified shop tests for motors shall be performed as specified in Section 26 05 91 – Low-Voltage Electric Motors.

C. Certified shop tests for instrumentation and controls shall be performed as specified in Section 40 80 81 – PMCS Factory Testing.

D. The manufacturer shall submit a statement certifying that the specified shop test has been performed and a test report showing capacity, differential pressure, power requirements, and other data to the Engineer for approval prior to shipment in accordance. The entire assembly shall be prepared for shipment in accordance with the manufacturer's recommendations. Certified testing materials shall be provided as specified in Section 01 43 15 – Witness Shop Testing. No witness to shop testing shall be provided.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. In general, workmanship and finish of all metalwork shall be of the highest grade and equal to the best practice of modern shops. Exposed surfaces shall have smooth finish and sharp, well defined lines. Materials of construction where not specified herein shall be suitable for the service encountered, and as approved by the Engineer.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the equipment is ready for continuous operation. Each component will be as fully assembled as transportation will allow. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built, and securely bolted thereto.

C. Finished iron or steel surfaces shall be painted per manufacturer's standard color as required in Section 09 91 00 – Painting. Each box or package shall be properly marked to show its net weight in addition to its contents. All appurtenances shall be handled and stored in accordance manufacturer's recommendations and as specified herein.

3.02 INSTALLATION

A. General: Install equipment on vibration isolators in accordance with the Contract Documents and the manufacturer's instructions.

1. Piping: Equip with full-size flexible discharge connection, check valve, and isolation valve.

B. Air Compressor Piping:

1. Install in accordance with manufacturer's piping diagrams.

2. Pipe relief valve, tank drain, and separator drain to floor drain.

C. Field verify all dimensions and elevations. Notify Engineer of specific differences

D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

E. Surface preparation and field painting shall be in accordance with Section 09 91 00 – Painting.

F. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03 FIELD TESTING / QUALITY CONTROL

A. Inspect and test installed air compressor as described in this section to demonstrate that the unit and its controls function correctly.

B. Preliminary Field Tests: Test compressor unit to demonstrate the following:

1. Equipment has not been damaged by transportation or installation.

2. Equipment has been properly installed.

3. Equipment has no mechanical or electrical defects.

4. Drives are properly aligned.

5. Drives and piping are properly connected.

6. Equipment is free of overheating of any part.

7. Equipment is free of objectionable vibration and noise as specified.

8. Equipment is free of overloading of any part.

9. Controls and monitoring provisions operate as specified.

10. Noise does not exceed code allowable values.

C. Final Field Tests:

1. Start-up services and acceptance testing will be performed by the manufacturer under direct assistance of the Contractor as specified herein.

    a. At the completion of packaged compressed air system installation, the system shall be started under the supervision of the manufacturer. Manufacturer shall first inspect the system to ensure that the equipment has been installed properly, has been properly lubricated and is ready to be started.

2. Prior to applying any electrical power to any motor driven equipment, the drive motor shall be rotated by an external to demonstrate free operation of all mechanical parts.

3. Unit shall be started and all signals monitored while equipment is subject to operating conditions as specified in Article 2.02 of this specification. All controls, interlocks, and alarms shall be checked to assure proper control and equipment protection. Equipment shall be accepted upon demonstration to the Engineer that each part and all parts together function as intended.

4. If the packaged compressed air system fails to fulfill the performance requirements specified, Contractor shall correct, adjust or modify the compressor package until specified performance is met. All expenses associated with the Field Tests, including any corrective action, shall be borne by the Contractor.

D. Testing and startup shall be performed in accordance with Section 01 75 10 – Preliminary and Final Field Tests and Section 01 79 05 – Equipment Start-up and Training, unless otherwise noted

3.04 STARTUP / DEMONSTRATION

A. Startup shall be performed in accordance with Section 01 79 05 – Equipment Start-up and Training and as specified herein unless otherwise noted

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Provide field touch up painting of scratched or damaged surfaces, using primer, intermediate and finish paints provided by the manufacturer, in accordance with Division 9, Finishes.

END OF SECTION

SECTION 43 12 60 –VACUUM PRIMING SYSTEM
CONTRACT PS 318

PART 1 GENERAL

1.01 SUMMARY

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and appurtenances required to furnish and install three (3) duplex vacuum priming systems to automatically prime three (3) centrifugal pumps. Each pump will have its own dedicated unit, ensuring reliable operation. The complete assembly shall include a horizontal vacuum tank, motors, pumps, control equipment, and accessories as shown and specified.

2. Overall system responsibility shall include factory tested, field testing, start-up, training, calibration and overall successful operation of the equipment. The Contractor through the Supplier shall guarantee and shall be the source of information for the complete system, including each piece of equipment furnished under this Section and other Sections, regardless of the manufacturing source of that equipment.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before the vacuum priming system Work.

C. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	2
1.03	Related Sections	2
1.04	references	2
1.05	Description	2
1.06	Quality Assurance	2
1.07	Submittals	4
1.08	Delivery, Storage And Handling	5
1.09	Spare Parts, Special Tools, And Supplies	6
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	9
PART 3	EXECUTION	11
3.01	Examination / Preparation	11
3.02	Installation	11
3.03	Field Testing / Quality Control	11

3.04 Startup / Demonstration 12
3.05 Adjusting / Protection / Cleanup.....12

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 78 25 - Operations and Maintenance Manuals

B. Section 01 79 05 – Equipment Start-up and Training

C. Section 09 91 00 – Painting

D. Section 40 61 96 – PMCS Control Strategies

E. Section 40 78 90 – PMCS Panel Mounted Instruments and Devices

1.04 REFERENCES

A. Standards referenced in this Section are:

1. ASME Section VIII, Division 1.

2. AWWA-C512, Standard for Air Release Valves.

3. UL, Underwriter’s Laboratories, Inc.

4. NEMA Standards.

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE

A. Supplier's Qualifications:

1. Supplier shall have a minimum of five years’ experience producing substantially similar equipment to that required for the Project and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section, regardless of component Supplier, from one vacuum priming system manufacturer.

2. Vacuum priming system Supplier shall review and approve or prepare all Shop Drawings and submittals for all components provided under this Section.

3. All components shall be suitable for specified service conditions and shall be integrated into the overall assembly by the vacuum priming system Supplier.

C. Certifications

1. Certification of Compliance:

a. Obtain certification of compliance with the Contract Documents from the vacuum priming system manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.

b. Certification shall be worded as follows:

1) "[Insert manufacturer's name] proposes to supply equipment included in Section 43 12 60 – Vacuum Priming System for NYCDEP. We have examined the Contract Documents and understand the Project requirements in so far as they affect the proposed products. We certify that the products will operate satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents.

2) [List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]

_____ _____
Authorized Signature & Title Date"

c. Provide justification for exceptions, variations, deviations, or changes. Engineer will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.

d. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.

e. Acceptance of certification shall not relieve Contractor of responsibility for adequacy of all products.

f. Submittal of certification shall not relieve Contractor and Supplier of requirement to comply with submittal procedures in the Contract Documents.

D. Factory Test Certification: Prior to shipping the complete system shall be factory tested and a test certification verifying that the system has been manufactured in accordance with the specifications shall be provided to DEP.

E. Professional Engineer:

1. Engage a registered professional engineer legally qualified to practice and experienced in providing the engineering services of the kind indicated. Professional engineer may be an employee of the manufacturer.
2. Submit qualifications data.
3. Responsibilities include but are not necessary limited to:
    a. Preparing or supervising the preparation of shop test set ups.
    b. Performing or supervising the performance of shop tests, interpretation, and engineering analysis of shop test data, and preparation of test reports.
    c. Certifying that the tests performed and the results achieved conform to the Contract Documents.

1.07 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
    a. Submittals of vacuum priming system controls, including panel layout and wiring diagrams. Conform to submittal requirements of Section, Process Control System General Provisions.
2. Product Data:
    a. Manufacturer's literature, illustrations, specifications, and engineering data including; dimensions, materials, size, weight, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.
    b. Vacuum pump performance data and curves showing overall pump efficiencies, flow rate, pressure, temperature, brake horsepower, motor horsepower, and speed.
    c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified.
    d. Motor Data: Provide maximum safe stall time, number of starts per hour.
3. Testing Plans, Procedures, and Testing Limitations:
    a. Provide Supplier's proposed shop testing plan, including complete list of testing facility limitations.
    b. Provide proposed field testing plan.

B. Informational Submittals:
1. Manufacturer Instructions:
    a. Provide Supplier's instructions for handling and installing products.

b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.

2. Quality Assurance Submittals

a. Provide certification of compliance as specified in Paragraph 1.3 C.1. and 1.3.C.D.

b. Qualifications of professional engineer as specified in Paragraph 1.3 E.

c. Provide resume of person from the manufacturer that will be responsible for the coordination of the complete vacuum priming system, including vacuum tank, pump, motor, and valves.

d. Location of nearest permanent service headquarters of manufacturer to the Site.

3. Source Quality Control Submittals:

a. Results of shop testing for complete vacuum priming system. Test results shall be certified by a registered professional engineer and signed by an officer of the manufacturing corporation.

4. Field Quality Control Submittals:

a. Results of field testing.

b. Submit a written report of the results of each visit to Site by manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

5. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Manuals:

a. Submit complete operation and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information.

b. Provide operation and maintenance manuals per Section 01 78 25 – Operations and Maintenance Manuals.

2. Warranty Documentation:

a. Manufacturer's Standard Warranty.

1.08 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as

required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.

2. Equipment shall not be shipped to the site until the Contractor has received written notification by the Engineer of their acceptance of the Shop Test results.

3. Deliver products to Site to ensure uninterrupted progress of the Work.

4. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.

B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Warranty on Vacuum Priming System:

1. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

2. Provide manufacturer's written warranty, running to the benefit of DEP, agreeing to correct, at DEP's option, remove, or replace materials or equipment specified in this Section and found to be defective for a period of two years after date of Substantial Completion. Replacement value of items regularly subject to wear in normal use, such as rotors, shafts and belt drives, may be pro-rated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Design and Performance Criteria

Tag No.	Number of Units	Name	Location	Type	Design Lift, ft	System volume to be evacuated, ft^3	Min Reciver Capacity, gal	Motor Size, HP	Vacuum Pump Capacity, ACFM
7401 7402 7403	3	Vacuum Priming System	Ground Floor @ El. 13.50 ft	Priming System	14	MSP 1601:190 MSP 1602:160 MSP	120	4	50

						1603:130			

B. Products and Manufacturers: Provide products of one of the following:

1. Premier Fluid Systems, Inc.
2. Or approved equal.

2.02 MATERIALS / EQUIPMENT

A. Vacuum Tank: The vacuum tank shall be a horizontal cylindrical tank with a minimum capacity of 120 gallons. The tank shall be constructed in accordance with ASME Code for Unfired Pressure Vessels and shall be designed for a maximum allowable working pressure rating of 200 psig at 450 ^{o}F and a minimum allowable pressure of full vacuum. The tank shall be equipped with:

1. Water level sight gauge with isolation cocks.
2. Vacuum gauge capable of indicating 0 inches Hg to full vacuum, with gauge valve.
3. High water level float switch.
4. Drain connection with drain valve.
5. Vacuum holding check valve on the vacuum line to each vacuum pump.
6. Vacuum valve with muffler.
7. Vent valve.

B. Vacuum Pump Assemblies

1. Each vacuum pump shall be of either the positive displacement dry reciprocating piston type, or the oil lubricated rotary vane type; pumps shall have an open flow (at 0” HGV) of no less than 50 ACFM, and an ultimate vacuum of 29.9 inches Hg.
2. Each pump shall be driven by an efficient TEFC motor with a minimum of 3 HP, and designed for 3 phase, 60 Hertz, 460 volts current.
3. The pumps shall be especially designed for pumping damp air which can normally be expected in priming duty.

C. The vacuum line shall be 2 inch in diameter and made of stainless steel. The line shall be connected to each vacuum priming valve with 1 inch stainless steel piping. All stainless steel piping shall comply with the requirements of the Contract Documents.

D. All interconnecting piping shall be made of stainless steel. All stainless steel piping shall comply with the requirements of the Contract Documents.

E. Accessories: Provide the following, as shown on Contract Drawings:

1. A 3-way electric actuated ball valve in the vacuum line between the vacuum pumps and the vacuum tank for system purge control and isolation of the vacuum pumps when they are not running.
2. Auto drain assembly to collect water accumulation from the vacuum tank. The assembly shall include:
3. ASME rated drain receiver
4. Two position level control switch
5. Two way normally open isolation solenoid
6. Two way normally close drain solenoid
7. Three way solenoid for controlling tank equalization and venting.
8. Interconnecting piping.

F. Priming Valves: Provide the following, as shown on Contract Drawings:

1. A single priming valve shall be provided at each pump and connected to the vacuum priming system. The inlet to the valve shall also be connected to the pump discharge piping. Each priming valve shall be provided with a suction isolation valve and a vacuum isolation valve. The outlet piping shall be connected to the vacuum priming system connection on the vacuum tank.
2. Valves shall be of the float operated, compound leverage type, and capable of automatically releasing accumulated air from the suction pipe.
3. The body and cover shall be of cast iron construction with all internal trim to be of stainless steel.
4. Valves shall be provided with back-flushing connections to allow complete flushing of the valve’s seat and internal components. Assembly shall include isolation valves for ease of maintenance. All process wetted parts components and piping shall be stainless steel.
5. Submersible solenoid valves shall be provided for vacuum priming valve isolation.
6. Stainless steel strainers shall be provided to catch solids upstream of the priming valves.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Contractor shall furnish and install equipment nameplates for the equipment in accordance with the Contract Documents.

B. Finishing:

1. Shop Finishing:

a. 1. Pumps, motors, and appurtenances shall be supplied with the manufacturer's standard epoxy primer and epoxy finish enamel

paint system suitable for sewage service. Skids, piping and supports shall be painted in accordance with Section 09 91 00 – Painting.

b. 2. Coat machined, polished, and non-ferrous surfaces with corrosion prevention compound.

2. Touch-up of factory-applied finishes shall be compatible with factory-applied finish and specified service conditions.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Packaged Vacuum Priming System Controls - General:

1. Controls shall provide manual and automatic operation of the equipment as shown and specified.

2. Relay based control logic shall be provided for starting, operating and stopping the vacuum pumps.

3. All control, instrumentation equipment shall conform to the requirements of Division 40.

4. All wiring, conduit and other electrical equipment shall conform to the requirements of the Contract Documents.

5. A motor starter and ETM located at the remote motor control center and a 460V disconnect at the skid shall be provided for each compressor.

B. Control Panel:

1. Duplex vacuum pumps shall be supplied with a Type 316 SS, NEMA 4X control panel with a duplex alternator. Control panel shall be U.L. listed and include controls, displays and features as required herein and as indicated on the Contract Drawings.

2. Control panel components shall comply with the requirements of Section 40 78 90 – PMCS Panel Mounted Instruments and Devices. Indicating devices and switches shall be mounted on the front door. Control switches and motor control and overload interfaces shall be pre-wired to the control panel for vacuum pump control and remote status and alarm monitoring.

3. The control panel shall be mounted and wired on the skid package and shall include the following instruments and devices:

a. Two (2) Hand/Off/Auto selector switches, one for each vacuum pump.

b. P1/ALT/P2 control selector switch.

c. Alternating relay and control logic relays.

d. Control Power indicator light, white.

e. Vacuum Pump 1 Run and Vacuum Pump 2 Run indicator lights, red.

f. Vacuum Pump 1 Overload and Vacuum Pump 2 Overload indicator lights, amber.

g. Low Vacuum indicator light, amber.

h. Vacuum Tank High Level indicator light, amber.

i. Reset button.

j. All control and indication functions are to be centralized on the control panel.

k. Provide dry contact outputs for remote monitoring of Vacuum Pump 1 Run, Vacuum Pump 2 Run, Vacuum Pump 1 Overload, Vacuum Pump 2 Overload, Low Vacuum and Vacuum Tank High Level.

C. Vacuum Pump Controls/Operation:

1. Provide fully automatic control of the pumps to maintain vacuum tank pressure within a preset range. The preset range shall be maintained via pressure settings. Field adjustable pressure switches shall be included with the vacuum priming system.

2. The vacuum priming system control panel shall start and stop pumps as necessary to maintain line pressure within the upper and lower operational pressure set points. The pressure shall be sensed via field adjustable pressure switches for normal on and off control, low system pressure and high pressure pump shutdown. Controls are as follows:

a. When the HOA switch is the Off position the pump will be off and a running pump will stop.

b. When the HOA switch is the Hand position the pump will run and will be shut off on high vacuum pressure.

c. Normal operation is with both HOA switches in Auto where the duty pump will turn on and off via the P1/ALT/P2 selector switch position and normal operating pressure switches. When the selector switch is set at Alternate (ALT), the duty pump alternates with each operation cycle. When selector switch is set to P1 (P1 duty, P2 standby) or P2 (P2 duty, P1 standby), there is no alternation with each operating cycle. If an overload occurs, the relay logic shall lock out the failed pump and shall operate the other pump.

3. Provide interlocking and sequencing to prevent pumps from operating simultaneously.

4. Automatic purge control shall be provided through solenoid valves that isolate the vacuum pumps from the receiver tank and process vacuum lines. On receiver high water level vacuum pumps shall stop to protect them from flooding.

5. Vacuum tank automatic draining shall be provided. Include low and high vacuum alarms as well as all other displays and functionalities as indicated on the Contract Drawings and as specified.

D. Vacuum priming valves shall be provided with submersible water level control switches providing level monitoring and maintenance indication outputs for interlocking with the associated pump start and for remote prime status indication. Switch maintenance output shall indicate that the switch is fouled/dirty and that cleaning of the priming valve is required.

E. A vacuum priming solenoid valve shall be provided on the vacuum priming line at each pump, as shown in Contract Drawings. The solenoid valves shall be interlocked with the pump start/stop sequence as described in Section 40 61 96 – PMCS Control Strategies.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install the vacuum priming system in complete accordance with manufacturer's instructions and recommendations and the approved Shop Drawings.

B. Anchorages:

1. Provide anchorages as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. Contractor shall coordinate with Supplier to assure timely receipt of required templates.

3.03 FIELD TESTING / QUALITY CONTROL

A. General:

1. All necessary testing equipment and manpower shall be provided by Contractor at their expense.

2. Submit written test procedure for each field test at least 30 days prior to date of testing.

3. Submit report for each test including test procedure, data, and results.

4. In the event that Contractor is unable to demonstrate to Engineer that the equipment meets the requirements specified herein, the equipment will be rejected and Contractor shall correct, adjust, modify, and/or replace the equipment and retest as often as necessary at their expense until acceptable results are obtained.

B. Running Test: After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a Running Test of the equipment and controls in the presence of Engineer to demonstrate that the unit and its controls function correctly.

3.04 STARTUP / DEMONSTRATION

A. A qualified, factory trained representative shall be provided for installation supervision, start-up and test services, and operation and maintenance personnel training services. The manufacturer's representative shall make a minimum of three visits to the Site as described below. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

1. First visit shall be for supervising unloading and handling of equipment and for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-site: 8 hours.

2. Second visit shall be for checking completed installation, start-up of system, and performing field quality control testing. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Minimum number of hours on-site: 16 hours, no more than 8 hours per day.

3. Third visit shall be for instructing operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01 79 05 – Equipment Start-up and Training.

B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to DEP.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 43 21 00.80 – FLOW CONDITIONING DEVICES AND APPURTENANCES
CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. Provide process pump flow conditioning devices and appurtenances as specified and indicated and in compliance with Contract Documents.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	1
1.04	References	1
1.05	Description	2
1.06	Quality Assurance:	2
1.07	Submittals	2
1.08	Delivery, Storage And Handling:	3
1.09	Spare Parts, Special Tools, And Supplies	3
1.10	Warranty	3
PART 2	PRODUCTS	4
2.01	Manufacturers	4
2.02	Materials / Equipment	4
2.03	Fabrication / Assembling / Finishes	4
2.04	Source Quality Control / Shop Tests	4
PART 3	EXECUTION	4
3.01	Examination / Preparation	4
3.02	Installation	4
3.03	Field Testing / Quality Control	4
3.04	Startup / Demonstration	4
3.05	Adjusting / Protection / Cleanup	5

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 01 43 10 – Quality Assurance Inspection

B. Section 01 65 00 – Product Delivery Requirements

C. Section 01 66 00 – Protection of Materials & Equipment

1.04 REFERENCES

A. ASTM International (ASTM):

1. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2. A778: Standard Specification for Unannealed Austenitic Stainless Steel Tubular

B. American National Standards Institute (ANSI):

1. B16.5: Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard
2. Hydraulic Institute (HI):
   a. Current Standards.
   b. 9.8: Rotodynamic Pumps for Pump Intake Design
   c. 9.6.6: Rotodynamic Pumps for Pump Piping

1.05 DESCRIPTION

A. Not Used

1.06 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01 43 10 – Quality Assurance Inspection.

B. All devices of the same design shall be the product of one manufacturer.

C. All flow conditioning devices shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

1.07 SUBMITTALS

A. Submit the following shop drawings:

1. Certified drawing including dimensions, weight, welding requirements, material designations, material thicknesses, bolting patterns, vane details and flange details for review with respective pump submittal.
   a. Electronic files shall conform to the following minimum requirements:
      1) Electronic Files: AutoCAD latest version, drawn to scale.
      2) Submit electronic files as part of the Shop Drawing submittal.
      3) Drawings shall include plan views, sectional views, title block, Tag Numbers, serial numbers, Parts List (identifying

each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

4) Drawings shall be in conformance with all other requirements as specified in this Section.

2. Shop drawing data for accessory items.

3. Listing of reference installations as specified with contact names and telephone numbers.

4. Recommendations for short and long-term storage.

B. A copy of the contract mechanical process drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this Section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this Section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.08 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01 65 00 – Product Delivery Requirements and Section 01 66 00 – Protection of Materials & Equipment.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 WARRANTY

A. Not Used

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Not Used

2.02 MATERIALS / EQUIPMENT

A. Provide vaned floor cones where indicated and of the size and configuration as indicated.

B. Provide vaned floor cone design approved by a nationally recognized physical hydraulics modeling laboratory.

C. Provide lifting ports on two vanes

D. Material:

1. Type 316L stainless steel
2. Hardware: Type 316 stainless steel to match floor cone

E. Finish: Passivated

F. Manufacturers

1. Flow Optimizers, LLC
2. Or approved equal

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Not Used

3.02 INSTALLATION

A. Install items in accordance with accepted Shop Drawings, manufacturer's printed instructions and as indicated.

B. Install vanes and cones in the orientation indicated.

3.03 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.04 STARTUP / DEMONSTRATION

A. Not Used

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 43 23 31.05 – VERTICAL CENTRIFUGAL PUMPING UNITS (DRY PIT SUBMERSIBLE FOR RAW WASTEWATER SERVICE) CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, as shown, specified and required, to furnish and install all vertical centrifugal pumping units and appurtenances, complete and operational. This Section describes the specific requirements for vertical centrifugal Pumping Units (dry pit submersible for raw wastewater service), and supplements Section 43 05 21 – Common Work Results for Pumping Units. Pumping Units shall be as specified herein and as shown on the Contract Drawings.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	4
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	5
1.09	Spare Parts, Special Tools, and Supplies	5
1.10	Warranty	6
PART 2	PRODUCTS	6
2.01	Manufacturers	6
2.02	Materials / Equipment	6
2.03	Fabrication / Assembling / Finishes	20
2.04	Source Quality Control / Shop Tests	20
PART 3	EXECUTION	23
3.01	Examination / Preparation	23
3.02	Installation	23
3.03	Field Testing / Quality Control	24
3.04	Startup / Demonstration	24
3.05	Adjusting / Protection / Cleanup	25

C. The following schedule, attached after the End of Section designation, is a part of this Section:

1. Schedule 43 23 31.05-1, Vertical Centrifugal Pumping Units (Dry Pit Submersible for Raw Wastewater Service) Characteristics.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the

applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

B. This specification is a sole source procurement. Attached in Exhibit A is the Brand Name Specification Memorandum which provides the scope of supply for the sole source procurement.

C. Any additional equipment, items of work and labor and materials that are necessary to complete this installation, that are not specifically included in the scope presented in Exhibit A, shall be furnished and paid for by the Contractor under the Lump Sum bid for Contract.

1.03 RELATED SECTIONS

A. Section 01 43 15 – Witness Shop Testing

B. Section 01 78 25 – Operations and Maintenance Manuals

C. Section 05 56 00 – Metal Castings.

D. Section 09 91 00 – Painting

E. Section 26 05 91 – Low-Voltage Electric Motors.

F. Section 26 24 19 – Motor Control Centers

G. Section 40 05 19 - Ductile Iron Process Pipe.

H. Section 43 05 21 - Common Work Results for Pumping Units

I. Section 40 61 13 – PMCS General Requirements

J. Section 40 61 96 – PMCS Control Strategies

K. Section 40 67 16 – PMCS Panels and Enclosures

L. Section 40 79 91 – PMCS Field Instruments

M. Section 40 80 81 – PMCS Factory Testing

N. Section 43 05 21 – Common Work Results for Pumping Units.

1.04 REFERENCES

A. Reference Standards:

1.	ASTM A48	Standard Specification for Gray Iron Castings.
2.	ASTM A532	Standard Specification for Abrasion-Resistant Cast Irons.
3.	ASTM A536	Ductile Iron Castings.
4.	ANSI/HI 14.6	Rotodynamic Pumps For Hydraulic Performance Acceptance Tests
5.	ASTM A743/A743M	Standard Specification for Castings, Iron-Chromium Nickel, Corrosion Resistant, for General Application.

6. Hydraulic Institute (HI) Standards
7. National Electrical Manufacturers Association (NEMA)
8. Underwriters Laboratory (UL)
9. Factory Mutual (FM)
10. National Electric Code

1.05 DESCRIPTION

A. Pumping Units shall be single stage, vertical, non-clogging, bottom inlet, centrifugal, and dry pit submersible.

1. Pumping Units shall include reducing inlet elbow and support base plate for dry pit service.
2. Pumping Units shall include stand-alone cooling jacket with integral self-contained cooling system.
3. Pumping Units shall be suitable for continuous operation in wet or dry pit applications without overheating.

B. Pumping Units shall be direct-mounted and close-coupled.

C. Seals shall be by a double/tandem mechanical seals.

D. Service Description:

1. Pumping Units shall be for raw wastewater service, which shall be assumed to contain:
   a. Solids ≤ 4-in. in diameter.
   b. Solids content: 5±%
2. The liquid pumped shall be presumed to contain rags, tramp metal, stringy material, grit, sand, gravel, metal turnings, broken glass, condoms, sticks, hair and a vast variety of other materials often found in a combined sewer system.
   a. All Pumping Units shall be capable of pumping sewage containing solids up to the size stated herein.
3. Pumping Units for grit shall be suitable for the following conditions as well:
   a. Pumps shall be used continuously in an on-off operation.
      1) Pumping Units shall be capable of at least ten (10) evenly spaced starts per hour at maximum speed and be able to operate throughout the entire pump performance curve from shut-off through run-out.
   b. Pumping Units shall be explosion proof and fully submersible up to 25 feet above the inlet pipe level and suitable for dry pit applications.

4. The Pumping Unit (including the pump, motor, and the power and control cables) shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class I, Division 2 for Dry-Pit Pumps, Group D service as determined and approved by a U.S. nationally recognized testing laboratory (UL, FM, CSA) at the time of equipment delivery.

1.06 QUALITY ASSURANCE

A. Quality assurance for all vertical centrifugal Pumping Units shall comply with the requirements of Section 43 05 21 - Common Work Results for Pumping Units.

B. Shop inspection shall be made by NYCDEP representatives. Inspection instructions shall be issued to the Manufacturer upon receiving the purchase order copy and approved shop drawings from the Contractor through ePMIS. Inspections consist of verifying the materials with the Certified Material Test Reports (CMTR), collecting samples, inspecting welds, verifying dimensions, and finishing inspections.

C. Witnessed hydrostatic and performance shop test shall be performed in accordance with Section 43 05 21 – Common Work Results for Pumping Units.

D. QA inspections shall include (but no be limited to) the following activities:

1. Obtain representative material samples of main components.
2. Obtain copies of Certified Materials Test Reports (both chemical and physical) and Manufacturer's Certificates of Conformance.
3. Perform visual and dimensional inspection of completed work.
4. Testing of mechanical and chemical properties (sample(s) as required)
5. Witness surface preparation and coating and lining operations, paint peel tests, and holiday tests.
6. Witness any required hydrostatic, shop leakage and performance tests.
7. Perform ASTM A380 water test (Stainless steel).

1.07 SUBMITTALS

A. Submittals for all vertical centrifugal Pumping Units (dry-pit submersible for raw wastewater service) shall comply with the requirements of Section 43 05 21 - Common Work Results for Pumping Units. In addition, submittals shall include, but not be limited to:

1. Action Submittals:

a. Details of the integral, closed loop cooling system, including (but not limited to):

1) The motor cooling jacket.
2) The internal coolant impeller.
3) The inspection ports.

b. Details of the Main Sewage Pumps Control Panel (MSPCP) in accordance with the submittal requirements in Section 40 61 13 – PMCS General Requirements.

2. Information Submittals:

a. Certified Material Test Reports:

1) The liquid used for the integral, closed loop cooling system.

B. Operation and Maintenance Manuals: Operation and Maintenance (O&M) Manuals shall be submitted in accordance with Section 01 78 25 – Operations and Maintenance Manuals.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this Section, marked to show all changes necessary for the equipment proposed for this Specification Section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this Specification Section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up Specification Sections and/or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up Specification Sections and justifications are submitted in a complete package.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling for all vertical centrifugal Pumping Units (dry-pit submersible for raw wastewater service) shall comply with the requirements of Section 43 05 21 - Common Work Results for Pumping Units.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Provide spare parts, special tools, and supplies in accordance with the requirements of Section 43 05 21 - Common Work Results for Pumping Units. In addition, the Contractor shall provide the following:

1. Spare parts:

a. Two (2) uninstalled Main Sewage Pumps (MSPs).

b. One (1) complete set of gaskets for each pump furnished.

c. Two (2) spare impellers for each individual pump furnished.

d. Two (2) sets of impeller wear rings for each individual pump furnished.

e. One (1) each of the following: PEM, BU, PA, CU, NIU, MultiSmart, HMI, circuit breaker (each type), 24VDC power supply, UPS.

f. Six (6) each of the following: control relays, fuses, terminal blocks, selector switches, indicating lights, pushbuttons.

2. Provide spare parts for electric motor in accordance with the requirements of Section 26 05 91 - Low-Voltage Electric Motors.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Vertical Solids Handling Pumping Units (Dry Pit Submersible for Wastewater Service):

1. Xylem/Flygt Corporation Pump shall be Model NT 3202 LT3-616. This specification is a sole source procurement.

2. Pump Main Control Panel

a. Xylem/Flygt U. S. -Flygt Nexicon Pump Controller.

3. Pump Monitoring System

a. Xylem/Flygt U. S. -MAS 801

B. Pumping Units and controls shall be provided by a single supplier who will take unit responsibility for the system.

2.02 MATERIALS / EQUIPMENT

A. Design Criteria:

1. Refer to Schedule 43 23 31.02-1, located after the "End of Section" designation.

2. Pumping Units shall be capable of pumping against a closed valve (shut off head) for 2 min without damage to any part of the Pumping Unit or its mechanical seals.

B. Pumping Unit Components

1. General:

a. All materials shall be of a quality to withstand the hostile environment and stresses to which the Pumping Units and components may be subjected.

b. All castings shall conform to the requirements of Section 05 56 00 - Metal Castings.

2. Impellers

a. General:

1) Impellers shall be of the semi-open, dynamically balanced, screw-shaped, single-stage, end-suction, centrifugal flow non-clog type with a minimum number of vanes.

a) Impellers shall be built to pass sand, grit, solids, trash, rags, condoms, sticks and stringy material with maximum freedom from clogging.

b) Vanes shall be back-swept .

c) Vanes shall have long through-lets without acute turns.

d) Impeller shall be balanced to ISO 1940-1.

e) The screw shape of the impeller inlet shall provide an inducing effect.

2) The waterways through the impellers shall have smooth contours and shall be free from sharp edges.

b. Materials of Construction:

1) Hard Iron or stainless steel.

2) Hardness:

a) Impeller leading edge: Rockwell C $\geq$ 60 RHC.

3) Impeller key, lockwasher, bolt, and locknut: Type 316 stainless steel

c. Assembly:

1) Impellers shall be key seated and securely held to the shaft by a key, lockwasher, and locknut, or by lockwasher and bolt.

a) The arrangement shall be such that the impeller cannot be loosened by torque from either forward or reverse rotation.

b) Designs based on threaded connection between pump shaft and impeller will not be considered.

2) The use of wearing rings or surfaces located on the upper side of impellers and casings, with or without the use of flush or pressure water as a means of balancing hydraulic thrust, will not be considered.

3. Pump Shafts:

a. General:

1) Pump and motor shaft shall be the same unit.

2) Motor shaft shall extend into the pump volute where impeller is mounted on the shaft.

3) Motor shall be isolated from the pumped media by using shaft seals as specified herein.

b. Materials of Construction:

1) AISI Type 431 stainless steel.

4. Casing:

a. General:

1) Shall consist of, at a minimum, single castings for the volute and the stator housing.

2) The arrangement of the casing shall permit ready removal of the impeller.

3) The casing shall have a tangential discharge.

a) Pump designs with volutes having a centerline discharge shall not be accepted.

b) It is the Contractor's responsibility to ensure that the pump casing submitted fits within the existing pumping station without any modification to the piping layout shown on the Contract Drawings.

4) The casing shall have standard Class 125 inlet and outlet flanges.

b. Material and Construction:

1) For the motor housing:

a) Casings shall be made of ductile iron conforming to ASTM A536, Grade 65-45-12.

2) For the volute casing:

a) ASTM A532 Alloy III A 25% Chrome Cast Iron.

3) Casings shall be of ample thickness of at least the minimum thickness per manufacturer standard and, where required for

additional rigidity, shall be ribbed to prevent excessive deflection.

4) Casing shall have sufficient strength to support the electric drive motor.

c. Appurtenances:

1) Handle:

a) Each Pumping Unit shall be provided with a handle that is rated for the entire weight of the Pumping Unit.

b) Materials: Type 316 stainless steel.

2) Sole Plate:

a) Provide a sole plate for each Pumping Unit.

b) Sole plate shall be made of be made of ductile iron conforming to ASTM A536, Grade 65-45-12.

3) Lifting Eyelets:

a) Provide three (3) cast lifting eyelets for each Pumping Unit.

b) Eyelets shall be located at the top of the Pumping Unit.

5. Suction Elbow:

a. General:

1) A reducing suction elbow shall be provided with each dry-pit submersible pumping unit as shown on the Contract Drawings. Suction elbow material shall be recommended by the pumping unit manufacturer.

2) The size and dimensions of the suction elbow shall be as recommended by the pumping unit manufacturer.

b. Materials and Construction:

1) Each suction elbow shall be ductile iron and conform to the requirements of Section 40 05 19 - Ductile Iron Process Pipe.

2) All suction elbows and fittings shall have an interior coating of Protecto 401, 40 mils thick, ceramic epoxy coating as manufactured by Induron Coating Corporation or approved equal.

3) Each suction base elbow shall be furnished with an approved, conformed inspection and cleanout cover.

4) The cleanout cover shall be secured to a machined face on the elbow with Type 316 studs and nuts.

5) Ductile iron shall conform to ASTM A536, Grade 65-45-12.

6) The size of the cleanout opening shall be the larger of the following:

a) As large as the bore permits; or

b) 6-in.

7) The cleanout on the base elbow shall be located nearer the discharge end of the elbow (i.e., the end nearer the volute of the pump)

c. Appurtenances:

1) The clean-out hand hole shall be provided with a removable cover, secured to a machined face with Type 316 stainless steel studs and nuts.

2) Provide a compatible flush valve, metal-seated gate valve, for each pump unit. See Specification Section 40 05 56 – Process Valves, Smaller than Four-inch Diameter.

3) Gage Taps:

a) Provide a plug tap for a suction gage in each suction elbow.

b) The pump manufacturer shall provide a plug tap for the discharge gage on the volute of the pump immediately adjacent to the discharge pump nozzle as shown on the Contract Drawings.

c) Gages shall be installed so that gage centerlines and pump centerlines are at the same elevation, unless otherwise shown or specified.

d) Taps shall be of the following type, unless otherwise shown or specified:

(1) Suction gages: compound.

(2) Discharge gages: pressure type.

e) Tap diameter: 1½-inch.

f) Connecting pipe:

(1) Provide connecting pipe from the gage taps to the gages in accordance with the requirements of Section 43 05 21 - Common Work Results for Pumping Units.

(2) Diameter: 1½-inch.

(3) Material: red brass

(4) End connections: threaded.

6. Support:

a. General:

1) Each Pumping Unit shall be furnished with an integral support base.

2) The size and dimensions of the base shall be as necessary and required to support the Pumping Unit as shown on the Contract Drawings.

3) The pump base shall support the entire weight of the Pumping Unit and shall withstand all stresses thereon caused by vibration, shock direct, and eccentric loads.

b. Materials and Construction:

1) Heavy-duty cast iron or welded steel.

7. Bearings:

a. General:

1) The pump and motor shaft shall rotate on permanently lubricated upper and lower bearings.

2) One upper bearing shall be provided to compensate for radial forces.

3) One to two lower bearing(s) shall be provided to compensate for axial thrust and radial forces.

4) The minimum L10 bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

5) Provide re-lubrication ports with positive anti-leak plugs for periodic addition of lubricant from external to the pump without any need to dismantle the pump.

8. Mechanical Seals:

a. General:

1) Each pump shall be provided with a non-proprietary tandem mechanical shaft seal system consisting of two (2) independent seal assemblies:

a) The lower seal unit; and

b) The upper seal unit.

2) Seals shall run in an oil reservoir, which provides constant lubrication and is easily accessible for draining and inspection.

3) The seals shall be replaceable.

4) Each seal interface shall be held in contact by its own spring system.

b. Materials and Construction:

1) The lower seal unit:

a) Located between the pump volute and the oil chamber.

b) Shall be designed for abrasive conditions.

c) Unit shall consist of:

(1) One (1) stationary seal; and

(2) One (1) positively driven rotating ring.

d) Both seal faces shall be of solid silicon carbide or tungsten carbide.

2) The upper seal unit:

a) Located in the oil chamber, which acts as a barrier between pump and motor.

b) Unit shall consist of:

(1) One (1) stationary silicon carbide or tungsten carbide ring; and

(2) One (1) positively driven rotating carbon graphite ring.

9. Pump Drive Units:

a. General:

1) Shall be of sufficient capacity to operate the pumps from shutoff head to the maximum rate of flow specified without overloading and without operating in e motor service factor

2) Shall be submersible type and capable of operating continuously when fully exposed to air (i.e., dry pit).

3) Motor shall be vertical, shell type design, housed in an air or liquid filled, watertight chamber, NEMA B type.

4) The motor shall be specifically designed for pumping media of up to 40° C (104° F) with no greater than an 80° C temperature rise.

5) The motor shall be designed for operation up to 40° C (104° F) ambient and with a temperature rise not to exceed 80° C.

b. Materials and Construction:

1) Stator:

a) The stator windings and stator leads shall be insulated, as a minimum, with moisture resistant Class F insulation rated for 155° C.

b) The stator shall be dipped and baked three times in Class F varnish and shall be heat shrink fitted into the stator housing.

c) The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

2) Cooling System:

a) The motor cooling system shall be a self-contained closed loop cooling system.

(1) The cooling jacket shall thus provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air.

b) Cooling shall be accomplished by circulating fluid through a jacket encircling the stator housing and dissipating the heat to the pumped liquid.

(1) Air-cooled type motors shall not be acceptable.

c) The cooling system shall provide for completely non-submerged pump operation in liquid or in air having a temperature of up to 40° C (104° F), in accordance with NEMA standards.

(1) Restrictions limiting the ambient temperatures at levels less than 40° C are not acceptable.

d) The motor cooling jacket shall be of :

(1) Type 316 stainless steel.

e) The internal coolant impeller, integral to the cooling system and driven by the pump shaft shall provide the necessary circulation of the cooling liquid (not the pumped media) through the jacket.

f) The internals to the cooling system shall be non-clogging by virtue of their dimensions.

g) The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports located 180° apart (fill port and drain port).

(1) Port diameter: ≥ 4 in.

3) Motor thrust bearings:

a) Motor thrust bearings shall be designed for continuous thrust loads under all conditions of pump operation from zero head to shut-off.

b) The minimum B10 bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

10. Pump Electronic Module (PEM)

a. A pump electronic module shall be installed in the pump providing for connection of pump sensors as well as measurement and logging.

b. Measurement values and other information shall be exchanged with a base unit in the Main Sewage Pump Control Panel (MSPCP) using an interference resistant digital communication bus.

c. The pump electronic module shall contain information about the pump as well as features for startup and service support:

1) Pump serial number and other data plate information.

2) Specific configuration of monitoring functions for the actual pump such as alarm limits, delays, reset types, etc.

3) Counters by which the system can generate service reminders in accordance with the service policy specified in the pump manual.

4) Data, operating statistics and alarms list with associated so-called black box to see the condition of the pump and enable quick troubleshooting and reporting.

5) Measurement data: The PEM database shall, for all monitoring channels, contain measurements taken each second and averaged data for effective analysis and troubleshooting.

Time Resolution	Time period	Max value	Min Value
Second	2 hours	-	-
Minute averages	1 week	*	**
Hour averages	1 year	*	**

24-hour averages	20 years	*	**

Measurement data linked to alarm events (so-called "black box") shall be as follows:

Time Resolution	Time period	Max value	Min Value
Second	1 hour	-	-
Minute averages	6 hours	*	**

* Max value is the highest measurement value of resolution "second" within the averaged period.

** Min value is the lowest measurement value of resolution "second" within the averaged period.

11. Pump Sensors

    a. The pump shall be equipped with the following sensors that will be monitored by the PEM:

    b. Thermal contacts, one in each motor winding

        1) Leakage sensor in the stator housing

        2) Leakage sensor in the oil housing

        3) Pt100 for measuring motor temperature in one phase

        4) Pt100 for measuring temperature in main bearing

        5) Pt100 for measuring motor temperature in three phases

        6) Pt100 for measuring temperature in the support bearing

        7) Three-axis vibration sensor for vibration speed (mm/s or inch/s). Frequency Range 10 - 600 Hz.

        8) To comply with explosionproof rating, a separate normally-closed dry contact shall be provided in the pump motor to be wired separately in a conduit to the pump starter.

12. Submersible Power and Control Cable:

    a. Each pumping unit shall be provided with Flygt SUBCAB screened (or shielded) submersible cable consisting of:

        1) Power cable: three phases and ground

        2) Control cable: twisted pair of screened control cable designed to communicate between the PEM and Flygt MAS 800 protection and monitoring system.

    b. Flygt shall determine the sizes and quantities of cables in accordance with NEC and ICEA Standards.

    c. Cables shall be FM-approved for use in explosionproof areas.

d. Cable strain relief shall be provided.

e. Cables shall be sufficiently long to connect to the MCC starter without a junction box and with minimum 15% coiled slack.

f. No splices will be allowed in the cables between the pump and MCC starter. Cable length shall be identical for all pumps.

g. Cable and conduit penetrations into the Electrical Room shall be watertight under flooding conditions to preserve the submersible design of the underground Electrical Room.

h. Materials and Construction:

1) Outer sheath shall be made of chlorinated polyethylene CPE type with the following features:

a) High temperature resistance (withstands water temperatures up to 70°C)

b) Superior mechanical strength

c) High abrasion and tear resistance

d) Extremely low absorption rate, withstands water depths up to 50 meters

e) Chemical resistance (pH 3–10)

f) Ozone resistance in compliance with EN 50396 and ISO 4892-2

g) Oil and flame resistance according to IEC-norm 60811-1-1 and VDE 0472.

2) Cables shall have an advanced insulation compound/inner sheath of HEPR/3GI3 (high density ethylene-propylene rubber) or EPR/3GI3 (ethylene-propylene rubber), with temperature rating of 90°C.

3) Conductors shall be made of high grade electrolytic copper, finely stranded for extra flexibility, and conforming to UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords.

i. Cable Entry Seals :

1) The cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal.

2) The cable entry shall consist of grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter.

3) The grommets shall be compressed by the cable entry unit, thus providing a strain relief function.

4) The assembly shall provide ease of changing the cable when necessary, using the same entry seal.

5) The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.

6) Epoxies, silicones or other sealing systems shall not be accepted and shall not be considered equal.

C. Pump Protection, Monitoring & Control

1. General:

a. The Contractor shall ensure that the pump manufacturer design, furnish, shop test and supervise the installation of Main Sewage Pumps Control Panel MSPCP-1600, Backup System Control Panel BSCP-9120, instrumentation and controls, to ensure coordinated function as a system, providing and accepting appropriate signals to start, control speed and stop the pumps as required for safe, trouble-free operation.

b. MSPCP-1600 and BSCP-9120 shall occupy the same enclosure, but their components shall be grouped and wired separately from each other. Due to space limitations, physical size of the enclosure shall not exceed the size shown on the Contract Drawings.

c. The Contract Documents summarize major features but do not purport to cover all details required for complete design of the instrumentation and control system.

d. All instrumentation and control items furnished under this Section shall conform to the requirements of Section 40 61 13 - PMCS General Requirements, Section 40 79 91 - PMCS Field Instruments and Section 40 79 80 - PMCS Panel Mounted Instruments and Devices.

e. Control panels shall conform to all requirements of Section 40 67 16 - PMCS Panels and Enclosures.

f. Refer to the control strategy specified in Section 40 61 96 – PMCS Control Strategies.

g. Reduced voltage solid-state starter (RVSS or “Soft Start”) with bypass starter shall be provided in the Motor Control Centers (MCCs) specified in Section 26 24 19 – Motor Control Centers.

2. Main Sewage Pumps Control Panel MSPCP-1600

a. MSPCP shall include:

1) Pump monitoring and protection system, Flygt MAS-801 in conjunction with pump electronic module PEM.

2) Pump power analyzer, Flygt PAN 312, with current transformers to be installed in the MCC starter.

3) Pump control system, Flygt MultiSmart Controller with Input/Output expansion unit, for automatic operation with the primary and secondary wet well level systems, flow and level transmitters, and check valve position switches.

4) Human Machine Interface (HMI), Flygt 15-inch color touch screen

5) Manual control devices, indicating and alarm lights, and other devices shown on the Contract Drawings.

6) Uninterruptible power supply (UPS), 1500 VA, 120V, with status and alarm contacts.

7) Power Supply, 24 VDC, power rating as required.

8) Control and interposing relays, circuit breakers, fuses, surge protective devices, terminal blocks, and other accessories to make the control panel complete and operational.

9) NEMA 12 enclosure as shown on the Contract Drawings.

b. Pump monitoring and protection system

1) Base Unit (BU): Each pump shall have a Flygt MAS 811 base unit to be able to:

a) Stop the pump if required via a protective interlocking relay that works in any mode of control via the MSPCP, BSCP, and manual devices.

b) Function as a gateway by relaying data between the central unit (CU) and the pump electronic module (PEM) that collects data from the various pump sensors.

c) Provide for connection of measuring modules such as a power meter and other I/O modules.

2) Central Unit (CU): The central unit shall have a functionality based on embedded web pages that can be used through a PC or operator panel that allows:

a) A graphical user interface for configuration and analysis via computer and HMI.

b) Pump status overview.

c) Alarm management.

d) Analysis through trend graphs and histograms.

e) Communication with the SCADA Panel via the network interface unit.

f) Storage of the same pump data and logged data in each pump electronic module for quick access and redundancy.

c. Pump Power Monitoring:

1) Each pump shall have a Flygt PA 312 power analyzer for measuring the following electrical quantities.

a) Main voltage

b) Voltage imbalance

c) Pump power

d) Current imbalance

e) Power factor

f) Energy

d. Pump Controller and Operator Interface:

1) MultiSmart as manufactured by Xylem Flygt.

2) The pump station controller shall provide automatic control of three pumps with an HMI display interface, including pump sequencing, pump flow and pressure monitoring, wet well level control with either primary or secondary level system, and automatic switchover to backup level system.

3) Programmability: The product shall have the option of IEC61131-3 and IEC61499 compliant PLC programming language.

4) User Interface: The pump controller shall include a 15-inch color touchscreen user interface (HMI) for operation and configuration. The interface display shall provide status of most aspects of the pump station, control of pumps, resetting faults, and configuration of parameters.

5) Communications: The pump controller shall be able to support Ethernet Modbus RTU protocol communications.

6) Environmental:

a) Working temperature: -10C to +60Cb.

b) Storage Temperature: -40C to +90

c) Humidity: 5% to 95% (non-condensing)

d) Enclosure Ratings: Controller - NEMA 1, Display - NEMA 4X, Cabinet – NEMA 12.

7) The system shall support the service and maintenance policy that applies to the pump by generating service reminders and graphically providing users with an overview of service status that facilitates planning of upcoming service.

8) When a pump related alarm is generated, the system shall support the user in the form of:

a) Measurement data linked to the specific alarm item for analysis.

b) Text information about possible root cause errors.

c) Remedial actions.

3. Backup System Control Panel BSCP-1920

a. The BSCP shall consist of completely hardwired electro-mechanical devices such as control relays, selector switches, pushbuttons, indicating lights, and terminal blocks.

b. In case the MSPCP is out of service, automatic operation of the BSCP shall be controlled by the wet well backup level system consisting of float switches hardwired to the BSCP.

c. Backup mode and pump sequencing may be manually selected using selector switches in the BSCP.

d. Indicating lights on the BSCP shall indicate high-high level alarm, low-low level alarm, and backup system active.

e. The BSCP shall be integrated in the same enclosure as the MSPCP.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Provide identification, painting, and appurtenances in accordance with the requirements of Section 43 05 21 - Common Work Results for Pumping Units.

B. After assembly of shaft, sleeve and impeller, the rotor assembly shall be statically and dynamically balanced.

C. The equipment and non-stainless steel surfaces provided under this Section shall be prepared, primed and painted with finished coat in accordance with the requirements of Section 09 91 00 – Painting.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. In addition to the tests to be performed under Section 43 05 21 – Common Work Results for Pumping Units, the following tests are required:

1. Measurement of the operating internal temperatures of the pump bearings.

B. The Contractor shall be responsible for expediting all required tests by the manufacturer and the independent testing laboratory.

C. Certified witnessed shop tests shall be performed for all equipment provided under this Specification, as specified below and in Section 43 05 21 - Common Work Results for Pumping Units and Section 01 43 15 – Witness Shop Testing. For applications where multiple impeller sizes are provided, the Contractor shall conduct complete shop testing for all sizes. All applicable submittals shall be provided for each impeller size tested.

D. Certified shop tests for pumps shall be performed in accordance with ANSI/HI 11.6 (latest version) as specified in Section 43 05 21 - Common Work Results for Pumping Units and further detailed in this Section.

1. Shop tests shall be witnessed and certified.

2. Hydraulic performance testing shall be conducted. Equipment performance documentation shall include sufficient test points (not less than 10 for head and capacity tests) to document performance at full speed at the shutoff, primary, and runout design points.

3. Acceptance criteria for head and capacity test results, based upon the rated condition specified herein shall be acceptance Grade 1U as specified in ANSI/HI 14.6 and electrical and mechanical tests in accordance with ANSI/HI 11.6.

4. Hydrostatic Tests: All pressure sustaining parts shall be subjected to factory hydrostatic tests.

5. Test Setup Requirements: The test setup in the manufacturer's test facility shall duplicate the inlet conditions in the proposed.

6. Performance Guarantee Point: Pump performance, including flow, head, vibration, and efficiency shall demonstrate compliance with criteria in this Section.

7. Vibration displacement, velocity and/or acceleration readings shall be taken during all witnessed shop testing and the results recorded. Vibration shall not exceed acceptable limits defined in HI 9.6.4 and approved by the Engineer in advance of the testing.

8. All test results, including test logs and generated curves, shall be certified correct by the chief engineer or manager of the manufacturer's test facility.

E. Certified non-witnessed shop tests for motors shall be performed as specified in Section 26 05 91 – Low-Voltage Electric Motors.

F. Certified shop tests for instrumentation and controls shall be performed as specified in Section 40 80 81 – PMCS Factory Testing.

G. The manufacturer shall provide a letter report certifying that the unit has passed the specified test and inspection requirements. The entire assembly shall be prepared for shipment in accordance with the manufacturer's recommendations. Certified testing materials shall be provided as specified in Section 01 43 15 – Witness Shop Testing and Section 43 05 21 – Common Work Results for Pumping Units.

H. Pump Shop Tests: Shop Test all pumps provided under this Section.

1. Hydrostatically test pump bodies per ANSI/HI 1.6, to the greater of: under a hydrostatic head of at least 75 psi (500 kPa) or 150 percent of rated shutoff head.

2. Witnessed Factory Performance Test:

a. Pumps:

1) Testing of dry pit submersible pumps submerged is not acceptable.

2) Run pump at full speed rating point for 60 minutes prior to start of any testing.

3) Full speed tests:

a) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified per testing specification master.

b) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

c) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.

4) Each pump shall be subject to a witnessed performance shop test to determine the head, capacity, speed, brake horsepower and efficiency at each condition specified in the Design and Performance Criteria.

5) The tests shall be witnessed by one representative of the City and one representative of the Engineer.

a) The City and Engineer shall be informed of the test dates a minimum of six (6) weeks in advance. All travel and related expenses, such as airfare, car rental, lodging, meals, telephone, etc., of the witnessing City and witnessing Engineer shall be included in the Contract Price. If air travel is more than 6 hours, provide business class airfare.

6) Testing of all pumps shall be concurrent. If testing of all pumps cannot be performed within a single workweek, a second representative of the City and Engineer shall witness subsequent factory testing. All related expenses shall be included in the Contract Price. At no time shall a

representative of the City or Engineer be scheduled to attend factory testing for longer than one workweek.

7) If equipment fails tests, re-testing shall be scheduled as soon as possible. Re-testing shall be done within the constraints of the City and Engineer. Contractor shall bear all costs and expenses of re-testing.

b. Operate each pump for not less than 60 minutes to determine that the pump will operate without vibration or cavitation at the minimum flow and at runout with not more than the specified NPSH available.

c. Operate each pump at full speed at the minimum allowable flow for a minimum of two minutes. Inspect the wear rings for contact by removing the suction cover. Pumps exhibiting contact shall be rejected.

d. All other performance test procedures not stated above shall be in accordance with ANSI/HI 11.6 and ANSI/HI 14.6.

1) Repeat tests until results indicate compliance with the Contract Documents. All pumps shall meet the acceptance grade specified in the Design and Performance Criteria and as defined in ANSI/HI 14.6.

2) Submit five copies of all Shop Test results certified by a Professional Engineer and signed by an officer of the manufacturing corporation.

3) Equipment shall not be shipped to the site until the Contractor has received written notification from the Engineer of their acceptance of the results.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Inspection, installation of equipment and piping, and piping and equipment identification shall be in accordance with Section 43 05 21 - Common Work Results for Pumping Units.

3.02 INSTALLATION

A. Install all Pumping Units in accordance with the requirements of Section 43 05 21 - Common Work Results for Pumping Units.

B. Manufacturer's Representative:

1. The Contractor shall furnish the services of accredited representatives of the Pumping Unit manufacturer to supervise the installation, adjustment, and field tests of the equipment and to provide training for DEP operating personnel.

2. The services of the manufacturer's representative shall be furnished for installation supervision for at least the following number of days:

Visit:	Purpose:	Number of Visits:	Person-days per Visit:
No. 1	Installation Supervision	12	4

3. Should additional days of service be necessary for a successful installation, such services shall be provided by the Contractor at no additional cost to the City.

3.03 FIELD TESTING / QUALITY CONTROL

A. In addition to the field tests to be performed under Section 43 05 21 – Common Work Results for Pumping Units, the following tests are required.

1. Witnessed field testing with mechanical devices to prevent reverse rotation and for satisfactory reverse rotation prevention when such devices are not furnished in Pumping Units with drive units rated at one hundred and twenty-five (125) horsepower or greater.

2. Measure the bearing temperature:

a. Temperature readings in excess of 135° F shall be deemed presumptive evidence that the operating internal temperature of the bearings exceed 180° F, unless the Contractor can conclusively prove otherwise to the satisfaction of the Engineer.

1) In the absence of such proof, it shall be incumbent on the Contractor to take such steps as may be required to reduce the temperature to ≤ 135° F with no additional cost to the City.

B. The Contractor shall provide the services of the Pumping Unit manufacturer's representative at such times and for such durations of time as are needed to perform the field testing tasks required of the representative.

1. The services of a manufacturer's representative shall be furnished for field testing for at least the following number of days:

Visit	Purpose:	Number of Visits:	Person-days per Visit:
No. 2	Field Testing	12	2

3.04 STARTUP / DEMONSTRATION

A. Furnish the services of a qualified Pumping Unit manufacturer's representative to assist in the start-up of the equipment and train DEP operations and maintenance staff in the care, operation, and maintenance of the equipment in accordance with the requirements of the Contract Documents. In addition:

1. Contractor shall make all adjustments required to place Work in proper operating condition.
2. Contractor shall include in training of DEP personnel instruction on care and maintenance of the materials and equipment.
3. In the event of trouble with the equipment during startup / initial operation, the manufacturer's representative shall revisit the Site as often as required until all troubles are corrected and the installation is entirely satisfactory.

B. At a minimum, the services of the Pumping Unit manufacturer's representative shall be provided as indicated, below. The number of visits and person-days per visit indicated, below, shall be understood as referring to the total required services for the lot of equipment provided under this Section.

Visit:	Purpose:	Number of Visits:	Person-days per visit:
No. 3	Startup / Initial Operation	6	6
No. 5	Training	2	2

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Not Used

END OF SECTION

SCHEDULE 43 23 31.05-1
VERTICAL CENTRIFUGAL PUMPING UNITS (DRY PIT SUBMERSIBLE FOR RAW WASTEWATER SERVICE) CHARACTERISTICS

Process Fluid:	
• Fluid Pumped:	Raw Wastewater
• Free passage (minimum, as sphere):	≥ 4 in. diameter
• Temperature (max.)	104° F
Pump Characteristics (Each Pump):	
• Pump Type:	Rotodynamic Solids Handling
• Suction Diameter:	24-in.
• Discharge Diameter:	20 in.
Duty Point:	
• Flow:	7,920 gpm.
• Head:	25 ft TDH
• Pump efficiency:	≥ 81%
• Overall efficiency:(1)	≥ 74%
• Pump speed:	500 rpm

Shutoff Point:	
• Shut off head:	44 ft TDH
Runout Point:	
• Flow:	12,000 gpm.
• Discharge pressure:	12 ft TDH
Number Pumps:	
• Operating Pumps	5
• Standby Pumps	1
• Spare Pumps	2
Motor:	

• Power:	90 hp
• Speed:	500 rpm
• Drive Type	Constant speed
• Service Factor:	1.15
• Electrical supply:	460 V, 3 phase, 60 Hz
• Area Classification:	Class 1, Division 2, Group D.

Notes:

1) Refer to ANSI/HI 14.6 for definitions of efficiency

NO TEXT ON THIS PAGE

SECTION 43 41 13 – WELDED STEEL TANKS

CONTRACT PS-318

PART 1 GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, and appurtenances as shown, specified, and required, to furnish, install, and test above ground steel tank(s) complete and operational, and in conformance with all applicable federal, state, and local codes.

B. The following index of this Section is presented for convenience:

Article	Title	Section Page
PART 1	GENERAL	1
1.01	Summary	1
1.02	Payment	1
1.03	Related Sections	2
1.04	References	2
1.05	Description	3
1.06	Quality Assurance	3
1.07	Submittals	4
1.08	Delivery, Storage, and Handling	6
1.09	Spare Parts, Special Tools, and Supplies	7
1.10	Warranty	7
PART 2	PRODUCTS	7
2.01	Manufacturers	7
2.02	Materials / Equipment	7
2.03	Fabrication / Assembling / Finishes	8
2.04	Source Quality Control / Shop Tests	12
PART 3	EXECUTION	13
3.01	Examination / Preparation	13
3.02	Installation	14
3.03	Field Testing / Quality Control	14
3.04	Startup / Demonstration	15
3.05	Adjusting / Protection / Cleanup	15

C. The following schedules, attached after the “End of Section” designation, are a part of this Section:

1. Schedule 43 41 13-1, Welded Steel Tank Schedule.

1.02 PAYMENT

A. No separate payment shall be made for performing any Work required under this Section. All costs for Work required by this Section shall be included in the applicable lump sum, unit price(s) or allowance(s) as set forth in Section 01 27 00 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 05 05 23.01 – Welding

B. Section 05 05 23.02 – Miscellaneous Metal Fastenings

C. Section 05 12 00 – Structural Steel Framing

D. Section 05 50 00 – Metal Fabrications

E. Section 09 91 00 – Painting

1.04 REFERENCES

A. Abbreviations and Acronyms:

1.	CMTR	Certified Material Test Reports
2.	COC	Certificates of Conformance
3.	FRP	Fiber-Reinforced Plastic
4.	NDE	Nondestructive Evaluation

B. Definitions:

1. Petroleum Storage: Storage of fuel oil, gasoline, heating oil, or waste oil.

C. Reference Standards:

1.	ANSI/NFPA 704	Identification of Fire Hazards of Materials
2.	API 650	Welded Steel Tanks for Oil Storage
3.	ASME B16.5	Pipe Flanges and Flanged Fittings
4.	ASTM A516	Standard Specifications for Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Services
5.	ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
6.	AWWA D100	Welded Carbon Steel Tanks for Water Storage
7.	FDNY	New York City Fire Code
8.	NYCBC	New York City Building Code
9.	NYCMC	New York City Mechanical Code
10.	NYSDEC	Chemical Bulk Storage (CBS) Regulations (6NYCRR Parts 596 – 599)
11.	NYSDEC	Petroleum Bulk Storage (PBS) Regulations (6NYCRR Parts 613)
12.	U.L. 142	Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids

13.	29 CFR 1910	OSHA Standards for General Industry
14.	29 CFR1926	OSHA Standards for Construction

1.05 DESCRIPTION

A. This Section includes requirements for providing aboveground welded steel tanks (vertical top covered tanks or horizontal tanks made of carbon steel with coating as needed for corrosion resistance) built in accordance with the applicable standards and regulations for petroleum storage at ambient temperature and atmospheric pressure. Project-specific requirements can be found in Schedule 43 41 13-1, Welded Steel Tank Schedule, located after the "End of Section" designation.

B. All aboveground steel tanks shall be provided by one (1) manufacturer with sole responsibility for the satisfactory manufacture, delivery, installation supervision, compatibility, and performance of the tanks.

C. The steel tanks shall be furnished complete with liquid level gages, all accessories, spare parts, base attachments, mountings, anchor bolts and other appurtenances as specified or as may be required for a satisfactory installation.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have a minimum of five (5) years' experience in the design and fabrication of welded steel tanks of similar size, capacity, and type shown and specified.

B. Equipment furnished under this Section shall be the standard product in regular production of the manufacturer, unless otherwise specified.

C. All equipment provided under this Section shall be obtained from a supplier or manufacturer who shall assume full responsibility for the completeness of the system.

1. The supplier shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

D. Structural design computations shall be performed by a registered Professional Engineer licensed in the State of New York that is experienced in the design of welded steel tank vessels.

E. At a minimum, the following shop inspection operations shall be conducted by the Engineer:

1. Inspection at the shop is intended as a means:

a. Witness sampling and testing of materials.

b. Access traceability and condition of materials prior to fabrication and obtain representative material samples in accordance with the Detailed Specifications as deemed necessary.

c. Review and obtain copies of Certified Material Test Reports (CMTR's) (both chemical and physical) and test reports for susceptibility to inter-granular corrosion, Certificates of Conformance (COCs), Manufacturer's Certification, and QC Material Traceability Data as applicable.

d. Witness fabrication and assembly operations and perform visual and dimensional inspection of in-process and completed work.

e. Evaluate welds and witness all applicable Nondestructive evaluation (NDE) tests and perform weld inspection per the contract requirements.

f. Inspect material surfaces and welds.

g. Witness required shop hydrostatic tests (prior to heat treatment).

2. Prefabrication Meeting:

a. The manufacturer shall schedule a pre-fabrication meeting before the start of work with the Engineer to ensure that all equipment, materials, skilled labor, and conditions are in place that are necessary to adequately perform the work and to establish all applicable inspection witness points.

Notice:

Contractor shall give a minimum 45 days' notice to the Engineer prior to the beginning of any work so that inspection may be provided.

3. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and the Engineer shall be allowed free access to the necessary parts of the Work.

4. Inspection shall be conducted by two (2) representatives of DEP. The Contractor shall bear all costs for travel, lodging, and boarding of these DEP representatives, for the inspection. The Contractor shall bear all similar costs if the equipment is rejected.

F. Rejection of Work:

1. The Engineer shall have the authority to reject any material or work which does not meet the requirements shown on the Contract Drawings or specified herein.

1.07 SUBMITTALS

A. Submittals shall include, but not be limited, to:

1. Action Submittals:

a. Suitable evidence of manufacturer experience in the design, fabrication, and successful operation in other facilities of welded steel tanks similar to that specified herein.

b. Shop Drawings and catalog data, including but not limited to:

1) Dimensions of tanks, fittings, attachments, and anchor bolt locations.

2) Wall thicknesses (shell, top, and bottom).

3) Location of all fittings, attachments, and joints.

c. Data sheets identifying all materials used and methods of fabrication.

d. Calculations:

1) Structural design computations for each tank signed and sealed by a New York State Professional Engineer.

2) For aboveground tanks only, calculations on tank hold-down lugs/anchor bolts to demonstrate they will hold the tank in place when an empty tank is subjected to buoyant forces created by a 2.25-foot depth (relative to tank bottom) of the stored liquid contained outside the tanks. These calculations shall include pretension and torque values for hold-down lugs and anchor bolts.

e. Complete assembly and installation drawings with clearly marked dimensions.

f. Weights of all component parts, weight of assembled units, and approximate total shipping weight.

g. Description of the Service conditions.

h. Shop and field testing procedures.

i. Certified copies of all factory test results.

j. Instructions for handling, storage, loading and unloading, and installation of tanks. These instructions shall include bolt torque values and detailed instructions for pipe connections.

k. A list of manufacturer's recommended special tools and spare parts to be supplied.

l. Operation and Maintenance Manuals, in accordance with the requirements of the Contract Documents.

m. Deviations from the Contract Documents.

2. Information Submittals:

a. Tank label information.

b. Affidavit from the manufacturer that:

1) The steel tanks can meet the specified performance requirements with the contained liquids specified herein.

3. The Contractor shall submit a report from the manufacturer for each visit to the Site of the manufacturer's representative.

a. The report shall provide complete information regarding the visit, including, but not limited to, dates, times, subject equipment, tasks performed, persons contacted, problem corrected, test results, training provided, and other pertinent information.

b. The report shall be certified by the equipment manufacturer, documenting the findings of the authorized person(s).

1.08 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver materials provided under this Section in accordance with the requirements of the Contract Documents In addition:

1. Mount tanks on padded cradles if shipped horizontally or on a suitable skid if shipped vertically.

2. Protect all flanged nozzles with wooden blinds bolted to the flange and having a diameter of 2inches greater than the outside diameter of the flange.

3. For all un-flanged components, provide either rigid plugs inside the ends to prevent deflection or wooden boxes.

4. Brace the open ends of tanks with a suitable stiffening member to prevent deflection.

5. Do not ship appurtenances or other pieces loose inside the tanks.

6. Load tanks with at least 2-inches clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.

7. Regardless of the mode of transportation, firmly fasten and pad all components to prevent shifting of the load or flexing of components while in transit.

B. The Contractor shall store and handle materials provided under this Section in accordance with the requirements of the Contract Documents. In addition:

1. Tanks shall be unloaded with care and Tanks and appurtenances shall be stored in a location where they will be free from damage and deterioration.

2. The Contractor shall provide the services of person(s) authorized by the manufacturer to witness the unloading at the Site of the equipment provided, and to ascertain the condition of said equipment.

1.09 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. The Contractor shall provide spare parts and special tools, necessary to service, disassemble, repair, and adjust the equipment, provided under this Section, and as per the requirements of the Contract Documents. In addition:

1. Top and side access covers shall be provided only where these covers are shown or specified.

2. Provide the following spare parts for each welded steel tank listed in Schedule 43 41 13-1:

a. One top access cover gasket and set of bolts, nuts and washers.

b. Additional spare parts as may be shown or specified.

1.10 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Names of manufacturers is provided for each type of welded steel tank type specified in Schedule 43 41 13-1, Welded Steel Tank Schedule, located after the "End of Section" designation.

2.02 MATERIALS / EQUIPMENT

A. Regulatory Requirements:

1. Petroleum Storage Tanks shall conform to the requirements of the City or local authorities having jurisdiction and to the NYSDEC PBS regulations.

2. All tanks in New York City shall comply with New York City Administrative Codes, including but not limited to the Building Code, Fire Code and Mechanical Code, as applicable.

3. All work associated with installation of the tanks shall be in compliance with OSHA Standards 29 CFR Part 1926 for Construction.

4. The design of tanks provided under this Section, including the provisions made for operation and maintenance of the tanks, shall take into full consideration OSHA Standards 29 CFR 1910 for General Industry.

B. General Design Requirements:

1. All material shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the liquids which the steel tanks are to contain and shall conform to all applicable requirements specified herein.

2. Steel tanks shall be designed to adequately support all static and dynamic loads imposed on the tank surfaces.

3. Unless indicated otherwise in Schedule 43 41 13-1, Welded Steel Tank Schedule, the tanks shall be designed as atmospheric tanks.

C. Petroleum Storage Tank Materials:

1. All materials to be incorporated in any structure of petroleum storage tanks (excluding plates) shall comply with API 650 or U.L. 142, as applicable.

a. Material for plates shall conform to ASTM A516 Grade 70.

b. Plate thickness shall be equal to the calculated design minimum thickness plus $^{1}/_{16}$-in.

D. Containment Structure

1. When required by Schedule 43 41 13-1 or shown on the Contract Drawings, a containment structure shall enclose the tank(s).

2. Containment structure, if shown or specified, shall conform to the applicable and appropriate requirements of federal, state and City/local authorities having jurisdiction.

2.03 FABRICATION / ASSEMBLING / FINISHES

A. Horizontal Steel Tanks:

1. The Contractor shall furnish, deliver, install, test and place in satisfactory operation the horizontal steel tanks of the dimensions and number called for in Schedule 43 41 13-1, Welded Steel Tank Schedule, or as shown on the Contract Drawings.

2. The steel tanks shall be horizontal cylindrical units with domed ends. Manholes shall be provided as called for in Schedule 43 41 13-1, or as shown on the Contract Drawings.

3. Steel tanks shall be furnished with lifting lugs, anchor straps, ladder clips, nozzles, drains, vents, mounting hardware and other appurtenances as called for in Schedule 43 41 13-1, or as shown on the Contract Drawings.

4. Steels saddles shall be provided and welded to the tank prior to coating the tank.

B. Materials used to aid in the fabrication of tanks shall not have a detrimental effect on the structural integrity of the tank.

C. All welding shall be performed in accordance with Section 05 05 23. 01 – Welding.

D. Lubricants, crayons, adhesives, and anti-weld spatter compounds shall not contain materials that will be detrimental to the tank. Attachments that will be welded to the pressure boundary shall not have a zinc or cadmium coating in the weld area within 12 mm (0.5-in.) of the weld.

E. Painting:

1. Tanks and connecting lines and adhesives shall receive a finish which shall be resistant to the liquids being handled.

2. Painting shall conform to the requirements of Section 09 91 00 – Painting.

   a. The exterior surfaces of all new aboveground storage tanks must be protected by a primer coat, a bond coat and two or more final coats of paint, or have an equivalent surface coating system designed to prevent corrosion and deterioration.

   b. In accordance with Section 09 91 00 – Painting, the Quality Assurance daily data records shall be maintained for all components, as applicable. This data shall include the results of Holiday testing, repair data and Adhesion Test (ASTM D 3359) Results and repair data signed and witnessed by inspector. These documents shall be submitted to the Engineer.

3. Painting shall comply with regulations dealing with the painting of exterior tank surfaces.

F. Accessories:

1. Tank Connections:

   a. Flanged nozzle connections shall be steel pipe welded to the tank(s) of the diameter and at the locations shown on the Contract Drawings and/or indicated in Schedule 43 41 13-1.

   b. Nozzle connections shall be perpendicular to the tank. Nozzles shall extend approximately 12-in. from the shell unless otherwise shown on the Contract Drawings.

   c. Nozzles shall be finished flush with the inside surface of the tank. Rating of flanges shall be as specified herein.

   d. Access manholes shall conform to the location, size and details as shown on the Contract Drawings. Gaskets shall be suitable for the liquid contained in the tanks. Each manway cover on vertical tanks shall be provided with a davit arm assembly designed by the tank manufacturer and one 6-inch handgrip welded to the exterior of manway cover. The davit arm assembly shall permit the manway cover to pivot in the horizontal plane to enable access and entry into the tank. Materials of the davit arm assemblies and handgrips, including fasteners, shall be equivalent to the tank shell material. All weldments of davit lugs to manway flanges and handgrip to manway shall be full penetration type welds.

   e. Pipe and flanges shall be of steel conforming to the Contract Documents and ASME B16.5.

f. Full couplings shall be used where threaded pipe connections to the tanks are required.

2. All tank accessories as shown on the Contract Drawings or required for operation of the fuel tanks shall be provided and shall include:

   a. Horizontal Spill Container.

      1) Free standing stainless steel 3.5 gallon capacity spill container for the 2000 gallon storage tank, as manufactured by Preferred Utilities Manufacturing Corporation, model 2 or equal, with 3 in fuel fill port, dry break connector, overfill alarm bell, overfill alarm light, alarm silence pushbutton, and model FA-S caution sign. Pipe stands for the spill container shall be stainless steel.

   b. Tank leak sensor

      1) Float switch type tank leak sensor, as manufactured by Preferred Utilities Manufacturing Corporation , model RBS or equal, shall be installed in the spill containment dike.

   c. Foot valve

      1) Single poppet foot valve with strainer, as manufactured by Preferred Utilities Manufacturing Corporation, or equal, shall be installed in the tank on the pump suction pipe.

   d. Vent cap

      1) Vent cap of cast aluminum construction, as manufactured by Preferred Utilities Manufacturing Corporation, or equal shall be installed on the tank vent pipe.

   e. Anti-syphon valve

      1) Anti-syphon valve, as manufactured by Preferred Utilities Manufacturing Corporation, model A or equal, shall be installed on the pump suction pipe at the highest point above the tank.

3. Tank Calibration:

   a. Tanks shall be furnished with calibrated charts showing the liquid contents in gallons per inch of tank depth.

   b. Four (4) reproductions of the gauge chart shall be furnished to the Engineer. Charts shall be enclosed in plastic envelopes and bound in hardback binders.

   c. Two (2) gauge sticks, graduated in feet, inches and eighths of an inch shall be provided, when indicated in Schedule 43 41 13-1, in the length specified. Gauge sticks shall be of wood and properly

treated after graduating to prevent swelling or damage from the liquid.

4. Liquid Level Gages:

   a. General: Liquid level gages of either the glass gage type or float type shall be furnished in accordance with the details called for in Schedule 43 41 13-1, specified herein or as shown on the Contract Drawings.

   b. Float type clock face level gage shall be male threaded Morrison Brothers, model 818 or equal, furnished with a vertical float chamber, indicator scale, upper and lower valves and all required supports. All components of the gage shall be resistant to the liquids being stored.

      1) Float chamber shall be a minimum of 2½ inches in diameter and shall house a stainless steel float which is coupled to the clock indicator mechanism with a stainless steel cable.

      2) Float gage shall be installed so that the full capacity of the tank shall be measured. The indicator scale shall be graduated to indicate gallons of liquid remaining in the tank.

      3) Float chamber shall be supported as shown on the Contract Drawings.

   c. Gages shall comply with the applicable regulations.

5. Miscellaneous Accessories:

   a. Anchor Bolts and Anchors:

      1) Anchor bolts, nuts and washers shall be of Type 316L stainless steel and shall be sized by the tank manufacturer and provided by the Contractor, and shall be of the size and diameter required for anchoring the tank(s) to the foundation.

      2) Attachment of the anchor bolts to the shell shall be through stiffened chair-type assemblies or anchor rings of adequate size and height and shall not add significant localized stresses to the shell.

      3) Material shall conform to the applicable requirements of Section 05 12 00 – Structural Steel Framing.

   b. Ladders and safety devices such as safety cages, rest platforms and handrails shall be provided as called for in Schedule 43 41 13-1, or as shown on the Contract Drawings, or the authorities having jurisdiction.

c. Supports and appurtenances as called for in Schedule 43 41 13-1, or as shown on the Contract Drawings shall be provided in accordance with the requirements of Sections 05 05 23.02 – Miscellaneous Metal Fastening, and 05 50 00 – Metal Fabrications.

6. Labels:

a. Tank Label: Provide Type 316 stainless steel tank labels containing the following minimum information:

1) Manufacturer

2) Model number

3) Capacity in gallons

4) Working Capacity

5) Total capacity or design capacity

6) Tank name

7) Tank equipment number

8) Manufacturer's serial number and purchase order number

9) Date of fabrication

10) Maximum allowable specific gravity of stored material

11) Design pressure and temperature

12) Resin name

b. Chemical Label: Provide label in accordance with National Fire Protection Association (NFPA) 704 and including the following information:

1) Contents

2) Viscosity

3) Hazard number

c. Size of label shall be as specified.

d. Labels shall comply with regulations dealing with required markings for chemical storage tanks.

2.04 SOURCE QUALITY CONTROL / SHOP TESTS

A. At a minimum, the following inspection operations shall be conducted:

1. Witness sampling and testing of materials.

2. Access traceability and condition of materials prior to fabrication and obtain representative material samples in accordance with the Contract Documents as deemed necessary.

3. Review and obtain copies of CMTR's (both chemical and physical) and test reports for susceptibility to inter-granular corrosion, COC's, Manufacturer's Certification, and QC Material Traceability Data as applicable.
4. Witness fabrication and assembly operations and perform visual and dimensional inspection of in-process and completed work.
5. Evaluate welds and witness all applicable NDE tests and perform weld inspection per the contract requirements.
6. Inspect material surfaces and welds.
7. Witness required shop hydrostatic tests (prior to heat treatment).

B. All tanks shall be hydrostatically tested for leakage by:

1. Temporary plugging of all tank openings, and completely filling each tank with water.
2. Applying air pressure of at least five (5) psig.
3. Repairing any leaks and retesting tank(s) until all leaks are eliminated.
4. Shop fabricated tanks shall be pressure tested for 1 hour prior to shipment to site.
    a. Tank manufacturer shall furnish certification to the Engineer that each tank received a hydrostatic test as specified herein above.
5. All materials, labor and equipment for tests and retests shall be furnished by the Contractor.
6. Method of inspecting joints shall be as specified.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Upon delivery of the steel tanks to the site, a thorough examination shall be performed. Particular areas to be inspected for damage are as follows:

1. Top of load (tank)
2. Widest part of load (tank)
3. At cradles or straps holding load (tank)
4. End blocking
5. All nozzles and manholes
6. Rotation of tank during transit

B. In the event the tanks are found to be damaged and, dependent upon the extent of the damage, the Engineer may:

1. Reject the tanks; or

2. Require the manufacturer to provide the personnel, materials, and equipment to perform the necessary repairs.

3.02 INSTALLATION

A. Installation equipment in complete accordance with the manufacturer's printed instructions and the approved shop drawings.

B. Install welded steel tanks in the locations shown on the Contract Drawings.

C. Tanks shall be installed in such a manner that connecting piping will not impose any strain on the tank connections.

D. Hold down lugs shall be bolted to the pad using anchor bolts at least ½-inch in diameter.

E. Any visual abrasions shall receive prime and finish coats compatible with the original finish in accordance with the manufacturer's recommendations.

F. Aboveground tanks must be supported on a well-drained stable foundation which prevents movement, rolling or settling of the tank and is designed to minimize corrosion of the tank bottom.

3.03 FIELD TESTING / QUALITY CONTROL

A. Furnish the services of a qualified manufacturer's representative to check and approve all installations before operation as well as conduct field testing, in accordance with the requirements of the Contract Documents. In addition, the manufacturer representative shall:

1. Verify that all work furnished and installed conforms to the requirements the Contract Documents.

B. Leakage Test:

1. Prior to putting tanks and connecting pipe into service, a leakage test shall be performed in the presence of the City and the Engineer.

a. Tank and pipe shall be completely filled with water and an air pressure of 5 psig shall be applied over a period of 2 hours and there shall be no leakage from the tank pipe.

b. In the event of leakage, the tank shall be considered damaged and the procedure outlined in Paragraph 3.01.B, above, shall be followed. Specifically, the Engineer may:

1) Reject the tanks; or

2) Require the manufacturer to provide the personnel, materials, and equipment to perform the necessary repairs.

c. Leakage tests shall be repeated for any replaced or repaired tank. Tank will not be accepted unless it passes the leakage test.

C. No additional payments will be made for tests or retests.

D. Passage of the leakage test does not relieve the Contractor from repairing leaks that may appear when the tanks are filled with the service liquid.

E. At a minimum, the services of the manufacturer's representative shall be provided as indicated, below. The number of visits and person-days per visit, indicated below, shall be understood as referring to the total required services for each individual tank provided under this Section.

Visit:	Purpose:	No. of Visits:	Person-days per visit:
1	Installation Checkout	1	1
2	Leakage Test(s)	1	1

3.04 STARTUP / DEMONSTRATION

A. At completion of the generator field testing, the Contractor shall refill both tanks with ultra-low sulfur diesel fuel.

3.05 ADJUSTING / PROTECTION / CLEANUP

A. Cleaning

1. Interior of tanks shall be cleaned of all foreign matter and air dried before filling with diesel fuel.

END OF SECTION

SCHEDULE 43 41 13-1

WELDED STEEL TANK SCHEDULE

Horizontal Tanks:

Tank:	Main Fuel Storage	Day Tank
Manufacturers:	Highland Tank Or Approved Equal	Preferred Utilities Manufacturing Corporation Or Approved Equal
Liquid contained:	Ultra-low Sulfur Diesel Fuel	Ultra-low Sulfur Diesel Fuel
Temperature range: (°F)	32 to 95	32 to 95
Viscosity:	##	##
Specific gravity:	0.8	0.8
Number of tanks required:	1	1
Nominal capacity: (gal)	2000	160
Horizontal tank nominal diameter: (ft)	5.3	##
Horizontal tank length: (ft)	12.83	##

Design Pressure/Vacuum Range: (psig)	5	5
Tank connections, description and diameter:	As shown on Contract Drawing	As shown on Contract Drawing--
Access manholes/Inspection Port:	One 24-inch diameter	6” square
Secondary containment:	Steel dike	Steel dike
Gauge Stick length, type	14-feet, folding	6-feet, one piece

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THE CITY OF NEW YORK

DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Invitation for Bids for Furnishing all Labor and Material Necessary and Required for:

PS-318

Reconstruction of Paerdegat Pumping Station

Volume 3 of 3
Contract Terms and Specifications
(with separate Bid Booklet)

September 2026